DOCUMENT RESUME

ED 472 676 IR 021 895

AUTHOR	Brown, Carol J.; Rojan, Amy
TITLE	Teacher Leadership Project 2002: Evaluation Report.
INSTITUTION	Bill and Melinda Gates Foundation.; Northwest Educational Service District 189, Mount Vernon, WA.
PUB DATE	2002-08-00
NOTE	106p.; Prepared by Fouts & Associates, L.L.C.
PUB TYPE	Reports - Evaluative (142)
EDRS PRICE	EDRS Price MF01/PC05 Plus Postage.
DESCRIPTORS	Computer Assisted Instruction; *Computer Uses in Education; Curriculum Design; *Curriculum Development; Elementary Secondary Education; Program Development; *Program Evaluation; Teacher Attitudes; *Teacher Leadership; *Technology Integration; *Technology Planning; Training

ABSTRACT

The Teacher Leadership Project (TLP) is a program developed to assist teachers in their efforts to integrate technology into the school curriculum. The program also encourages and facilitates teachers in assuming leadership roles to help schools and districts develop and implement technology plans, and to provide training in using technology. During the 2001-2002 school year, 1,000 new teachers were selected to participate in the TLP, bringing the total number of trained teachers to 2,400. Data on the program we regathered from reflective journals responses classroom observations, teacher and student surveys, and teacher interviews. Evaluation questions focused on four areas: teacher use of technology in the classroom; effects of the training program on the classroom and the school; teacher technology leadership activities; and appropriate use of technology for K-2 students. Additional findings emerged and offered insight into: successes and challenges of an integrated curriculum; the TLP training model; the Understanding by Design framework, and miscellaneous attitudes regarding educational computer technology. Several recommendations are offered. Appendixes include the teacher and student surveys, K-2 interview and observation protocol, and Year 3 and Year 4 interview and observation protocol. (Contains 46 references, 15 figures, and 4 tables.) (AEF)

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Teacher Leadership Project 2002

Evaluation Report

August 2002

Prepared for the
Bill & Melinda Gates Foundation
and
Northwest Educational Service District 189

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Executive Summary

Teacher Leadership Project 2002: Evaluation Report

Carol J. Brown
Amy Rojan

The Teacher Leadership Project is a program developed to assist teachers in their efforts to integrate technology into the school curriculum. The program also encourages and facilitates teachers in assuming leadership roles to help schools and districts develop and implement technology plans, and to provide training in using technology. During the 2001-2002 school year, 1,000 new teachers were selected to participate in the TLP, bringing the total number of trained teachers to 2,400. Data on the program were gathered from several different sources, including reflective journals responses classroom observations, teacher and student surveys, and teacher interviews.

EVALUATION QUESTIONS

Evaluation Question 1: *Are the teachers integrating and using the technology as intended? What level of technology integration have teachers achieved after at least two years in the program?*

Although practices differ based on several variables such as grade level, teacher experience with integration, technical support, students' technical skills, and classroom demographics, evidence indicated that teachers' efforts are serious and well-intentioned. As findings from precious evaluations have shown, first-year TLP participants faced numerous challenges in implementing an integrated curriculum, while second, third and fourth year participants found the process to be less stressful and generally more productive. Veteran teachers also found a comfortable balance in using technology and traditional resources, and could more easily identify those lessons that were enriched with technology and those that were not. Whatever their level of expertise, however, TLP teachers took the charge of "meaningful integration" seriously, and did whatever they could to design and facilitate powerful learning experiences for their students. And while transformation did not happen in all TLP classrooms, students and teachers recognized a number of ways in which the educational experience was strengthened when technology was integrated into the curriculum, including the development of technical skills, as well as changes in attitude, quality of work, student learning, classroom dynamics, and the role of the teacher.

Evaluation Question 2: *What effect has the training had on teaching and the classroom? What has been the longer-term impact of the program on the classroom and the school?*

The impact of the Teacher Leadership Project on teaching and learning, on classrooms, and on schools has been dramatic and significant, according to a majority of TLP participants. Students were more motivated to learn when technology was present, and teachers often found them to be more self-directed, more collaborative, more interested, and more on-task. Moreover, many teachers reported that their instruction was more substantive and the classroom environment more student-centered when technology is integrated into the curriculum. And although their perceptions were based primarily on anecdotal evidence, teachers and students were generally convinced that learning was increased in technology-rich classrooms. This is due in large part the availability of the Internet, which "put the world at their fingertips." The perception that the integration of technology had an impact on student achievement has been a consistent theme among TLP teachers over the four years of the program and certainly warrants further study. Finally, teachers believed that students were better prepared for the "real world" because of their technical competence.

Evaluation Question 3: *What leadership activities have teachers performed during the year?*

Teachers were grateful for the leadership opportunities made possible through their participation in the TLP, and they frequently took advantage of those chances to share their knowledge and expertise with colleagues. They served on technology committees, taught classes, presented at conferences, led and assisted at TLP training sessions, participated in grant applications, and provided technical support in various capacities In addition, some TLP teachers developed projects that connected student learning to the community. Students also took on leadership responsibilities in the classroom and in the school.

Evaluation Question 4: *What is the appropriate use of the technology for K-2 students?*

Clear patterns of use, benefits, and challenges have emerged over the past several years regarding technology integration in intermediate and secondary classrooms. After two years, such patterns are being uncovered at the primary level as well. Primary students learned technical skills, such as opening and closing programs, saving work, completing templates, designing Power Point slides, using various word processing features, and practicing their skills. Teachers also believed there was at least limited evidence to suggest that technology had an impact on student learning, most often in improving their reading and writing abilities. Attitudes and behaviors were affected as well, with most teachers reporting that their students were more motivated, more collaborative, and more persistent in the face of problems and frustrations. Their efforts

were not without challenges, however. Younger students were not able to use technology in the same ways as older students. Their still-developing reading skills limited their ability to use the Internet, and keyboarding and mouse control were challenging for some. In addition, younger students needed guidance in many of their computer activities, and teachers often had to rely on parents, aides, or older students to provide this assistance.

It is important to note that some of the challenges that arose during the first year of the K-2 implementation (2000-2001) were addressed by the ESD189. Modifications to the hardware specifications and to the K-2 training module had a significant impact on the success of the K-2 program during the second year. Teachers were unanimous in expressing enthusiasm for the required presentation / projection (Elmo) hardware. Nevertheless, questions remain regarding effective management strategies and the potential of 5-8 year old children to use technology meaningfully, given their limited fine motor skills and reading abilities.

Additional Findings

The 2001-2002 TLP Evaluation Report focused on four key research questions. However, additional findings emerged and offered valuable insight into: (1) successes and challenges of an integrated curriculum; (2) the TLP training model; (3) the Understanding by Design framework, and (4) miscellaneous attitudes regarding educational computer technology.

Teachers reported many successes as well as many challenges in attempting to integrate technology into the curriculum. Increased student motivation, interest, learning, and cooperation were among the benefits they observed. On the other hand, teachers were frustrated with the lack of technical support they received from their schools and districts, and with the limited amount of time they had for exploring and planning lessons and projects. In nearly every case, however, the benefits outweighed the frustrations, and by June teachers were looking forward to planning for another school year.

The response from teachers regarding their TLP training was enthusiastic and positive, with a number of teachers rating it the "best in-service" of their professional career. There were some teachers who did not find the Understanding by Design framework and training necessary, and as in previous years, many teachers expressed a need for ongoing (second year) training. In fact, they identified continued training as one of three essential elements of sound technology program.

Finally, a small but concerned group of TLP teachers discussed the reality of continuing to integrate technology into the curriculum as equipment begins to break down. They believe this will be a particular problem in schools that do not have the financial resources or the commitment to maintain and replace hardware and software.

CONCLUSIONS AND RECOMMENDATIONS

Findings revealed that the Teacher Leadership Project is a remarkably effective training model that embraces many of the conditions identified in the research literature as being critical to successful integration. The instruction and materials were well-received by teachers, administration of the program was organized and efficient, and participants were motivated to use their knowledge and skills. As in previous years, teachers noted the need for follow-up training sessions.

Teachers expressed frustration at the lack of technical support they received from their districts, and they struggled to find time to integrate technology in meaningful ways. Despite the challenges they encountered, however, teachers were overwhelmingly convinced that the benefits were worth the effort, and they reported that the impact on teaching and learning was significant. Attitudes, behaviors, learning, and work products were all improved, they believed, because of the opportunities afforded by a rich-technology environment.

Results from the evaluation suggested that teachers were indeed sharing their training with others in a variety of different ways including providing in-services to building and district colleagues, serving on building and district technology committees, providing technical support to their peers, and making presentations at professional conferences. Their contributions to the profession were many, and because of their efforts the TLP is having an impact far beyond the core group of participating teachers.

In an effort to understand the appropriate place of technology in K-2 classrooms, the evaluation continued the in-depth study of technology integration at the primary level. Patterns of use are emerging and it appears that there is variation in how kindergarten, first, and second grade students used computers. One of the most important findings was the degree to which teachers found technology useful for instruction and demonstration. In some cases computers and related technologies were used at least as often by the teacher as they were by the students.

Third and fourth year teachers remained generally positive about the potential of computers to improve teaching and learning. With time comes experience and with experience they found that integration becomes more natural. In addition, teachers reported that over time they found it easier to focus their efforts on student outcomes rather than on the technology. Veteran teachers continued to experience technical problems, and were more often confronted with maintenance and replacement issues.

Recommendations

1. Research literature supports the philosophical position of ESD189 in asserting that curriculum development is at the heart of any educational program, and thus even though reactions from teachers were mixed it is recommended that the program continue to emphasize curriculum development.

2. Teachers are an important resource and the Teacher Leadership Project should continue to involve teachers at all levels.

3. Continued training, sharing, and collaboration opportunities beyond the first year will serve to strengthen the efforts of the foundation, ESD189, and the Teacher Leadership Project.

4. The TLP should continue efforts to reinforce to participating districts the technical support criteria stated in the grant.

5. Publishing a list of relevant presentation and publication opportunities would be another way to encourage teachers' leadership skills and also to expand the influence of the TLP.

6. Including basic technical support strategies in the summer and follow-up training sessions would provide teachers with some means of self-support.

7. Teachers should continue to be encouraged to share their work and the work of their students beyond the walls of the classroom.

Specific recommendations regarding the K-2 component of the Teacher Leadership Project include the following:

8. Efforts made by the Northwest ESD to adapt training sessions to the specific needs of K-2 teachers should be continued, with special attention given to the unique requirements of kindergarten teachers.

9. Given the findings of the usefulness of the document camera and projector, continue to specify these as requirements for the K-2 teachers.

10. When selecting new K-2 participants, consideration should be given to the grade and skill level of students, and to the most appropriate hardware configuration for each situation. A stratified selection process would be reasonable.

11. Identifying, testing, and sharing potentially useful "primary" programs and applications with K-2 teachers in all TLP cohorts should be an intentional and ongoing goal of the program. The TLP website and listserve would be excellent avenues for sharing this information.

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Teacher Leadership Project 2002: Evaluation Report

INTRODUCTION

The Teacher Leadership Project is a program designed to assist teachers in their efforts to integrate technology into the school curriculum. Funded by the Bill & Melinda Gates Foundation and again administered by the Northwest Educational Service District 189, the program also strives to encourage and facilitate teachers in their efforts to provide technology expertise and leadership in and beyond their schools and districts. During the 2001-2002 school year, 1,000 new teachers were selected to participate in the TLP, bringing the total number of trained teachers to approximately 2,400. For the 2001-2002 Teacher Leadership Project evaluation, data were gathered from several different sources to answer four research questions: reflective journals responses were provided by first and second year teachers, classroom observations and teacher interviews were conducted in K-2 classrooms and in third and fourth year TLP teachers' classrooms, teachers completed a Technology Use Survey for Teachers, and a sample of students completed a Technology Use Survey for Students.

Description of the Teacher Leadership Project

A group of 27 teachers from schools across the state began the Teacher Leadership Project in 1997. This core group was instrumental in defining a vision for the TLP, and based on that vision they developed a model for creating technology-rich classrooms and integrating technology into the curriculum. Their initial efforts were promising, funding was increased, and since then the project has expanded considerably. During the 1998-99 school year 185 teachers were selected to participate in the program, and 215 more were brought on board for the 1999-2000 school year. An additional 1,000 teachers from grades K-12 received training during the 2000-2001 school year. Funding of the program will end after the final cohort of 1,000 teachers is trained in 2002-2003.

Teachers selected for the program in 2001-2002 each received $9,000 for the purchase of hardware to meet specific standards directed by the ESD189. Based on results of the 2000-2001 evaluation, the hardware configuration for primary classrooms was modified to include fewer student computers and more emphasis on presentation and projection hardware. As such, K-2 teachers received a minimum 1000 lumen portable projector, visual/desktop presenter (could include a combination of document camera and projector or all-in-one solution), three classroom computers, and one printer capable of handling the demands of three computers. For grade 3-12 classrooms the funding provided one multimedia computer for every four students, a printer, and a presentation device. As part of their grant each teacher was also provided with Office software, the Encarta Reference Suite, and SchoolKit (for Windows users). In addition, each

participant was given a personal laptop computer and was required to participate in 11 days of training over the course of their first year in the program. Training sessions were intended to help teachers (1) develop their technical skills, (2) design curriculum that utilized technology and was aligned with the state's Essential Academic Learning Requirements, and (3) identify leadership opportunities for sharing their knowledge and skills.

Background

The presence of computers and related technology in K-12 education continues to grow, and it is estimated that there are currently over 10 million computers in schools across the country (Becker, 2000). Student access to these computers is increasing, and in 2001 the student-to-computer ratio nationally was just over 4:1 (Skinner, 2002, p.1). Access to the Internet is also improving steadily, according to the U.S. Department of Education, and their data indicate that 98% of schools had Internet access in 2000 while 77% of classrooms had such access (U.S. Department of Education, 2001, p.1). This has resulted in greater student access to Internet-connected computers, which dropped to 6.8 students per connected computer in 2001. The figures for Washington state are similar, where the student to computer ratio is 3.9:1 and the student to Internet-connected computer ratio is 6.5:1.

Access does not ensure that technology will make a difference in teaching and learning however. Administrators of one district's technology integration program commented that "Although teachers now have the advantage of unprecedented access to technology in their classrooms and schools, we find, paradoxically, little evidence to indicate that teachers systematically integrate technology into classroom instruction" (Eastwood, Harmony, & Chamberlain, 1998, p.1). It has been suggested that technology, and the Internet in particular, has had relatively little impact on education because educators do not maximize its power. It is often used for routine tasks and thus "a most powerful and innovative technology [the Internet] is taken and domesticated, or if you want – trivialized, such that it does more or less what its predecessors have done, only it does it a bit faster and a bit nicer..." (Salomon, 2002, p.72). Others share this view. According to a recent report on technology and learning, while computers "can motivate students to take more interest in and control of their learning . . . the potential for technology to increase student achievement goes largely untapped" (Allen, 2001, p.2).

For their part, teachers often do not feel prepared to integrate technology into the curriculum. According to Meyer (2001), a majority of teachers surveyed reported not being given enough time to learn how to use technology as an instructional tool. Similar concerns were reported in a 1999 study conducted by the National Center for Education Statistics where it was found that only one in three teachers felt prepared to use the Internet for teaching and learning (NCES, 1999). In fact, training and time continue to emerge as critical factors in any successful technology integration program.

The Promise of Technology[1]

The changing use of technology reflects the changes in understanding over the last two decades about how the mind works and how children actually learn. There is a strong base of basic research that supports these ideas. This research is derived from the findings of researchers in developmental psychology, cognitive psychology, linguistics, and neuroscience and coupled with the philosophical ideas of constructivism (Duffy & Cunningham, 1996). Taken together they serve as the basis for many of the current beliefs about what and how children should learn in school. "Our understanding of human learning has....evolved based on a wealth of evidence collected over a wide range of different domains and media from which a process based on the passive assimilation of isolated facts to one in which the learner actively formulates and tests hypotheses about the world, adapting, elaborating, and refining internal models that are often highly procedural in nature" (Shaw & President's Committee of Advisors on Science and Technology, 1998). The National Research Council's Committee on Developments in the Science of Learning articulated an idea central to this new understanding of human learning: "A fundamental tenet of modern learning theory is that different kinds of learning goals require different approaches to instruction; new goals for education require changes in opportunities to learn" (Bransford, et al., p. xvi). "These new learning opportunities should take place in learning environments that are student centered, knowledge centered, assessment centered, and community centered..."

Their conclusions suggest that:

- Because many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge.
- Technologies can help people visualize difficult-to-understand concepts, such as differentiating heat from temperature. Students are able to work with visualization and modeling software similar to the tools used in nonschool environments to increase their conceptual understanding and the likelihood of transfer from school to nonschool settings.
- New technologies provide access to a vast array of information, including digital libraries, real-world data for analysis, and connections to other people who provide information, feedback, and inspiration, all of which can enhance the learning of teachers and administrators as well as students (Bransford, et al. p. xviii-xix).

Of particular importance to those involved with the Teacher Leadership Project is the potential for computers and related technological tools to be used in transforming the classroom, such that a student's educational experience is qualitatively improved. In the past decade, the use of computers has expanded from use primarily as an instructional delivery medium to use as a transformational tool and integral part of the learning environment. In fact, many proponents of the current reform efforts see technology as a vital component of a new educational paradigm in which the curriculum, teaching

[1] Taken from Fouts, J.T. (2000). *Research on Computers in Education: Past, Present and Future.*

methods, and student outcomes are reconceptualized (Means, 1994). This view was adopted by the U.S. Department of Education at least as early as 1993. In "*Using Technology to Support Education Reform*" (United States Department of Education, 1993) it was stated that "technology supports exactly the kinds of changes in content, roles, organizational climate, and affect that are at the heart of the reform movement."

Critical Factors in Technology Integration

As more schools across the country commit themselves to some sort of technology agenda, greater efforts have been made to determine the impact of such technology on teaching and learning. Are computers and related technologies being used to transform student learning? Larry Cuban, for one, has argued that computers are a mismatch with the requirements and conditions of teaching (Cuban, 1986; Cuban, 2000), and even those who are convinced that we are "on the verge of the dawn of a golden age for educational technology" suggest that technology has not yet lived up to its promise (Goldberg, 2002, p. 32). Still, clear patterns are emerging which document the benefits of technology-rich environments, including positive changes in student attitude and behavior, classroom dynamics, the role of the teacher, student learning and student work. The benefits of integrating technology into the curriculum are not the result of simply placing large amounts of technology in the classroom, however. Researchers are discovering a number of conditions that are critical to a sound technology program, and when such conditions are not met the chance of realizing these benefits is greatly reduced.

Teacher Training. At the heart of a successful technology integration program is teacher training. Researchers, administrators, and teachers have found that training in using computers is essential when attempting to infuse technology into the curriculum. Having the best computer, the fastest connection, and the latest software will not make a difference in the classroom if teachers are not trained in how to use them. "Beyond access, teaching teachers and students to use computers to enhance learning is a critical step in integrating technology into the curriculum" (Skinner, 2002, p.4). A review of research conducted by Sivin-Kachala & Bialo (1995) documented the benefits of technology in improving student achievement, students' attitudes, and the learning environment. Their conclusions, however, stressed the role of the teacher. "The decisions made by well-trained educators [necessarily] determine the computer's ultimate instructional effectiveness" (p.17). Others researchers agree. "The focus of integration is on pedagogy- effective practices for teaching and learning. Teachers need to be able to make choices about technology integration without becoming technocentric by placing undue emphasis on the technology for its own sake without connections to learning and the curriculum. For both preservice and inservice professional development, this means providing experiences, primarily in instructional design, media selection, modeling exemplary practices, clinical activities, resource sharing, and extensive and sustained training and practice" (Earle, 2002, p. 10). Still, training in using computers is not enough. According to Kearsley, training teachers to use computers without recognizing the importance of content and pedagogy proves "a distraction (on a grand scale) from what matters most – effective learning and good teaching" (1998, p. 47). "Teacher training . . . must be extensive and sustained and must focus on content (p. 49). A study

of teachers' pedagogical expertise and technology integration underscored the importance of knowing *what* to teach and *how* to teach (Pierson, 2001). Findings indicated that in addition to possessing technical skills, teachers needed to be knowledgeable of content and pedagogy to maximize the potential of technology. Pierson explained her conclusions as follows:

> Researchers (Berliner, 1986; Leinhardt & Greeno, 1986; Shulman, 1986; Wilson, Shulman, & Richert, 1987) agree that expert teachers possess both *content knowledge* and *pedagogical knowledge*, the intersection of which is described as *pedagogical-content knowledge*, or knowledge about specific learning, curriculum, and the various and most useful ways to represent the particular subject matter being taught. The findings of the present study suggest another component to the model, that of *technological knowledge*. This knowledge would include not only basic technology competency but also an understanding of the unique characteristics of particular types of technologies that would lend themselves to particular aspects of the teaching and learning processes. A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge. The intersection of the three knowledge areas, or *technological-pedagogical-content knowledge* would define effective technology integration (p. 427).

Pierson goes on to propose that "unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore, is likely as rare as [teaching] expertise[2] (p. 427).

Time and Support. While teacher training is clearly one of the most important elements in technology integration, other conditions have been identified as well. Time for teachers to collaborate and plan, adequate technical and administrative support, and access to hardware, software, and funding are essential to a sound technology plan. Research exists, in fact, to support the need for teachers to have planning and collaborative time when learning to integrate technology into the curriculum. It has been reported that "82% of teachers said they were not given enough time outside their regular teaching duties to learn, practice, or plan how to use the computers and other technologies" (Meyer, 2001, p. 50). In a study of laptop classrooms, Windschitl and Sahl found that one of the most powerful ways in which teachers increased their proficiency in using technology for teaching and learning was through regular collaboration with their peers (2002, p.202).

The importance of adequate hardware and technical support is becoming clear as well. When schools do not make provisions for maintaining and replacing technology, the promise of long-term success is greatly reduced. As those involved with one

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[2] "Expertise" or "Exemplary teaching" is defined by Pierson based on a framework from Berliner (1994). "Identifies seasoned teachers who posses the intuition to recognize patterns across unrelated activities and have contingency plans for the unexpected. Exemplary also describes those few highly motivated learners who interpret their environment in fluid, almost subconscious ways and act in anticipation of what is needed."

district's technology integration program observed "It is not surprising that only about five percent of instructional technology programs succeed or endure beyond a three-to-five year period. Several factors erode efforts a district might make to sustain an effective technology program: a focus on hardware rather than on processes, the recurring obsolescence of hardware, a weak planning process that fails to meet the needs of teaching and learning, little or no staff development, and no long-range plan for sustained effort (Eastwood, Harmony, & Chamberlain, 1998, p. 1). Indeed, according to the director of technology for the Abington (Pennsylvania) School District, the hardware itself can be a barrier to true transformation. He states:

> To have a truly transformational impact on education, technology must become ubiquitous. It must be always available, mobile, and flexible. It must be intuitive, reliable, and user-friendly to the point of being no more difficult to operate than a chalkboard, textbook, or overhead projector. It must be seamless and nearly invisible. At the moment, educational technology isn't any of these things" (Goldberg, 2002, p. 32).

Summary

As schools dedicate more and more resources to technology, questions remain about the impact on teaching and learning. While many believe that progress is being made in developing and implementing effective technology integration programs, there is general agreement among educators and researchers that such efforts are still in their infancy. "It may take a few more years for attitudes and technologies to mature to the point that the transformation is possible- but it will happen. Ubiquitous technology will have such an explosive impact on education that its results will become clearly visible to the naked eye, in stark contrast to today's inconclusive empirical studies (Goldberg, 2002, p. 34). And in response to Larry Cuban's contention that computers will play a minor role in changing student learning, Becker (2000) acknowledges that while there is the potential to transform education through technology integration, it has not happened yet.

> . . . in a certain sense Cuban is correct – computers have *not* transformed the teaching practices of a majority of teachers, particularly teachers of secondary academic subjects. However, under the right conditions – where teachers are personally comfortable and at least moderately skilled in using computers themselves, where the school's daily class schedule permits allocating time for students to use computers as part of class assignments, where enough equipment is available and convenient to permit computer activities to flow seamlessly alongside other learning tasks, and where teachers' personal philosophies support a student-centered, constructivist pedagogy that incorporates collaborative projects defined partly by student interest – computers are clearly becoming a valuable and well-functioning tool (Becker, 2000, p.29).

Research on educational technology, including qualitative studies, anecdotal reports, program evaluations, and a limited number of relevant quantitative studies, suggests that there are benefits when technology is integrated into the curriculum.

Students' attitudes, work products, and learning, as well as classroom dynamics and the role of the teacher are changed when technology is meaningfully infused into the teaching and learning process (Fouts & Stuen, 1997, 1999; Stuen & Fouts, 2000; Brown, Fouts & Rojan, 2001). On the other hand, there is mounting evidence of certain critical conditions that must be met for technology to be successfully integrated into the curriculum (Becker, 2000; Earle, 2002; Eastwood, Harmony, & Chamberlain, 1998; Salomon, 2002). These include teacher training, time to collaborate and plan, administrative and technical support, and hardware and software applications. The Teacher Leadership Project was designed to train and support teachers in Washington state to use technology for the transformation of student learning. The degree to which the program is effective can be measured in part by the degree to which they have successfully addressed these conditions. The evaluation of the TLP continues to assess their efforts in this regard.

Technology in Primary Classrooms

There is a continued interest among educators and others about the impact of technology on primary-age children, and for the second year the evaluation of the Teacher Leadership Project specifically focused on this area. This was done in an attempt to more fully understand how technology is best used in K-2 classrooms where children are in the early stages of literacy development. In addition, the evaluation was intended to identify specific successes and challenges faced by primary teachers in their integration efforts.

It is still the case that there are no definitive answers to the many questions about the use of technology in K-2 classrooms, although discussion of the issues continues. "Much of the controversy revolves around the specific needs of young children, and whether technology can support those needs, or will take away from essential developmental experiences" (Van Scoter, Ellis, & Railsback, 2001, p.1). This is particularly problematic given the limited amount of time primary teachers have to develop students' basic literacy skills.

Jane Healy has written several books on young children and learning and believes "An atmosphere of hysteria surrounds the rush to connect even preschoolers to electronic brains" (1998, p.20). A case in point is the increasing number of software programs available for young children, toddlers, and even babies. Jump Start Baby, Reader Rabbit Baby, and Baby WOW 2000 are just a few examples of educational programs designed for children. Healy is one of a growing number of professionals raising concerns about the impact of placing such sophisticated technology in the hands of preschool and primary age children. She suggests teachers and parents give serious consideration to when and how technology is introduced to young children. "If the computer can accomplish the task better than other materials or experiences, we will use it. If it doesn't clearly do the job better, we will save the money and use methods that have already proven their worth. In the case of the child under seven, there are few things that can be done better on a computer and many that fail miserably by comparison..... [they] are

better off spending this valuable time in a physically and linguistically enriched environment" (Healy, 1998, p.218).

Proponents of technology in primary classrooms believe there are benefits for even young children. Results of a study done by the National Research Council on brain development and learning revealed, for example, that "because many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge" (Bransford, Brown, & Cocking, 1999, p.xix). Susan Haugland, who has written frequently on issues dealing with children and technology, agrees. Their motor skills, mathematical understanding, creativity, problem solving and critical thinking skills are potentially improved when young children have access to technology (1999, p.29). Proponents also believe that the opportunities for young children to collaborate when using computers can be valuable. As well, it has been suggested that use of the keyboard gives young children greater freedom of expression (writing and drawing) since they are not constrained by their limited fine motor skills.

According to a statement by the National Association for the Education of Young Children (NAEYC, 1996), there are two important conditions to effectively using technology with primary-age children. First, the teacher must be skilled in making good decisions about which technology to use and in supporting children in their use of technology to ensure that potential benefits are achieved (NAEYC, 1996). Indeed, "The teacher's role is to set up the environment and activities, matching technology use to the curriculum as well as to the children's needs and interests. The teacher is less involved in directing the activities, and more involved in monitoring student activities, intervening as necessary to guide and pose questions that encourage thinking" (Van Scoter, Ellis, & Railsback, 2001, p.7). Evidence has revealed, however, that teachers are not given sufficient relevant training, nor do they feel prepared to use technology judiciously with their students (Gatewood and Conrad, 1997; Meyer, 2001).

Furthermore, teachers should use their knowledge of child development when evaluating and choosing primary software (NAEYC,1996). According to Haugland, "It is easy to become distracted by glitzy packaging and promises from manufacturers, losing sight of what is truly important: providing children with a sound educational tool for learning" (2000, p.13). Recommendations for age-appropriate software include identifying programs that (1) encourage exploration, imagination, and problem solving; (2) reflect and build on what children already know; (3) involve many senses and include sound, music, and voice; and (4) are open-ended, with the child in control of the pace and the path (NETC, 2000).

Summary

Questions remain about the most appropriate use of technology in primary classrooms. While a number of concerns have been raised about the impact of technology on children's social, emotional, physical and cognitive health, there are also reasons to believe that children may benefit from early exposure to technology.

"Computers are reshaping children's lives, at home and at school, in profound and unexpected ways. Common sense suggests that we consider the potential harm, as well as the promised benefits of this change" (Cordes & Miller, 2000, p.3). The evaluation of the Teacher Leadership Project, and of the K-2 strand in particular, continues to examine the program in light of this recommendation.

EVALUATION DESIGN

Evaluation Questions

The following research questions were the focus of the 2001-2002 TLP evaluation:

1. Are the teachers integrating and using technology as intended? What level of technology integration have teachers achieved after at least two years in the program?
2. What effect has the training had on teaching and the classroom? What has been the longer-term impact of the program on the classroom and the school?
3. What leadership activities have the teachers performed during the year?
4. What is the appropriate use of technology for K-2 students?

Data Sources

Data were gathered from several sources, including teacher reflective journals, a teacher use survey, teacher interviews, and classroom observations.

Teacher Reflective Journals. First year participants submitted reflective journals four times over the course of the school year. Teachers were asked to respond to the following questions in their journals:

Journals 1 and 2 (October and January)

1. In what ways have you integrated technology into the curriculum so far this year? *(Consider subject areas, projects or units of study, programs and applications)*
2. How have students, parents, and/or administration responded to your technology integration efforts?
3. What has gone well in your integration efforts? *(Consider specific projects and activities, student reaction and participation, support, etc.)*
4. What challenges have you faced? *(Consider technical issues, time and space issues, student management, support, etc.)*
5. What aspects of your TLP training have been helpful to you as you've integrated technology into the curriculum? What additional training would be useful?

Journals 3 and 4 (March and May)

1. In what ways have you integrated technology into the curriculum recently? *(Consider subject areas, projects or units of study, programs and applications)*
2. How have you used the *Understanding by Design* framework in your integration efforts?
3. What has gone well in your integration efforts? *(Consider specific projects and activities, student reaction and participation, support, etc.)*
4. What challenges have you faced? *(Consider technical issues, time and space issues, student management, support, etc.)*
5. In what, if any, leadership activities have you and/or your students been involved? *(Consider presentations, demonstrations, classes taught, etc)*
6. What evidence, if any, do you have that suggests students are learning differently and/or more because of the addition of technology to the curriculum; that is, how is their educational experience better because of their access to technology?
7. What aspects of your TLP training have been helpful to you as you've continued to integrate technology into the curriculum? What additional training would be useful?
8. What will you do differently next year? What will be the long-term impact of technology on student learning?

Second-year participants submitted journals twice during the year, in which they discussed their continuing integration efforts. Second year participants addressed the following questions:

Journal #1 (January)

1. How are you integrating technology into the curriculum during the second year?
2. How have your integration efforts been different during the second year?
3. How have you used the *Understanding by Design* framework in your integration efforts?
4. What has gone well in your integration efforts this year? *(Consider specific projects and activities, student reaction and participation, support, etc.)*
5. What challenges have you faced this year? *(Consider technical issues, time and space issues, student management, support, etc.)*

Journal #2 (May)

1. What evidence, if any, do you have that suggests students are learning differently and/or more because of the addition of technology to the curriculum; that is, how is their educational experience better because of their access to technology?
2. What are your views on integrating technology into the curriculum? Have your views changed this year? If so, how?
3. In what leadership activities have you been involved during this school year?
4. Has your school changed because of you participation in the TLP? If so, how?
5. How has your role as a teacher changed because of the addition of technology to the curriculum?

6. Based on your experience, what are the essential components of a sound technology integration plan? *(Consider hardware, software, training, support, management skills, space, etc)*

The number of teacher and student responses for the journals and surveys are shown in Tables 1-3.

Table 1: Journal Responses

Grade Band	2001 Cohort	2000 Cohort
K-2	101	100
3-5	1021	266
6-8	1102	189
9-12	896	88
Totals	**3120**	**643**

Table 2: Responses to the Technology Use Survey for Teachers

Grade Band	2001 Cohort	2000 Cohort
K-2	21	38
3-5	202	110
6-8	199	90
9-12	128	46
Totals	**550**	**284**

Table 3: Responses to the Technology Use Survey for Students

Grade Band	Students
6-8	469
9-12	203
Other	6
Total	**678**

RESULTS

Evaluation Questions: *Are the teachers integrating and using the technology as intended? What level of technology integration have teachers achieved after at least two years in the program?*

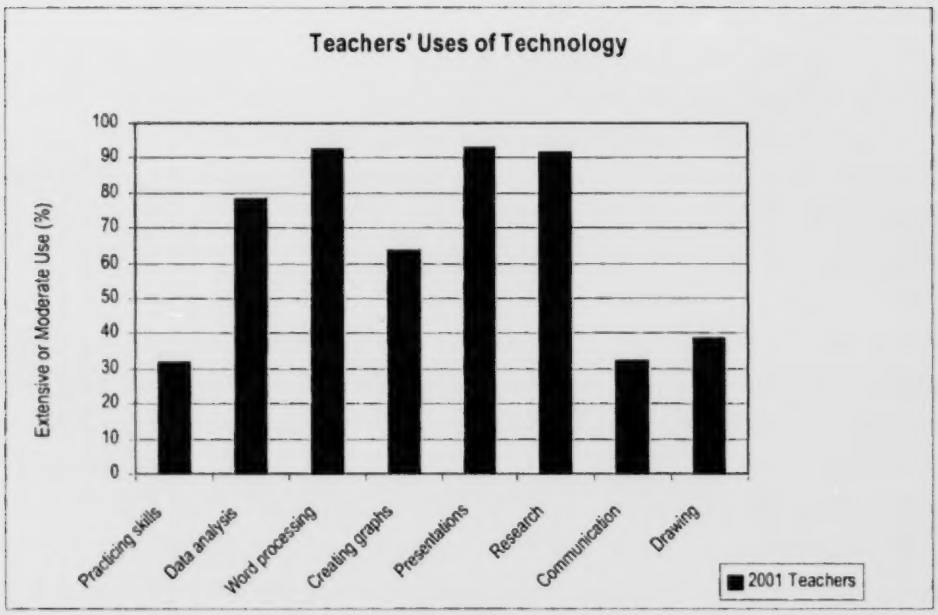
During the 2001-2002 school year, a total of 1,000 teachers in grades K-12 were selected to participate in the Teacher Leadership Project. To help understand the process of integrating technology into the curriculum these teachers were asked to respond to a number of questions regarding their first year experiences. From these responses, general patterns emerged which are useful in describing first-year integration efforts. In addition, 1,000 second-year teachers were asked to reflect on their experiences as well, and their responses shed light on the ways in which technology is used over time. Finally, third and fourth year TLP teachers shared their thoughts and experiences on integrating technology into the curriculum.

Use of Technology in the Classroom: Year 1

Teachers of grades 3-12 were provided with enough multimedia computers to achieve a 4:1 student to computer ratio as well as a presentation device and a printer capable of handling the demands of an 8-computer classroom. Based on results from the 2000-2001 TLP Evaluation Report, primary teachers were given a somewhat different configuration, including three desktop computers, a visual/desktop presenter (either a combination of document camera and projector or an all-in-one device), and a printer suitable for the demands of 3 desktop computers. All teachers were given their own laptop computer, Office software, the Encarta Reference Suite, and school access (for Windows users) to SchoolKit for one year. Any remaining funds were to be used for additional hardware, for upgrading the presentation device, or for reducing the student-to-computer ratio.

Journal responses indicated similar tendencies among teachers in how they infused technology into the curriculum. Office applications such as Word, Power Point, Encarta, and Excel were used consistently from the beginning of the year, as was the Internet. As teachers felt more comfortable with the process they were more likely to include Publisher, Front Page, SchoolKit, Inspiration, Kidspiration, Webquests, and various subject specific software programs in their efforts. Digital cameras, scanners, projectors, and document cameras were also used on a regular basis by many of the teachers. Patterns of use for all teachers in grades K-12 are illustrated in Figure 1, followed by a summary of teachers' integration efforts by grade band.

Figure 1



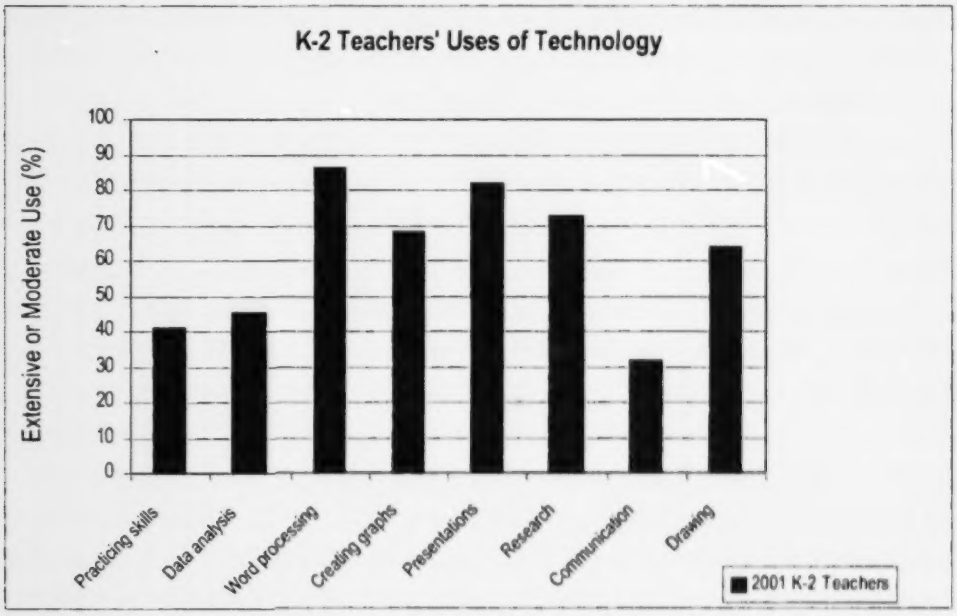
Grades K-2. Primary teachers found a number of ways to use their technology for teaching and learning (Figure 2). Writing was accomplished with Word, KidPix, and Kidspiration, Power Point was used for presentations, and the Internet, Encarta, and Golden Books were used for gathering information. Skill development software (Reader Rabbit, Bailey's Bookhouse) and Accelerated Reader were helpful as well. There was less use of SchoolKit and Excel.

Generally students used the computers to write and illustrate stories, journals, and letters, to make pages for class books, and to complete teacher-developed templates. While kindergarten, first and second grade teachers used similar programs, the complexity of the tasks was very much dependent on the abilities of the child. Lessons and projects in second grade classrooms often looked much different than those done in kindergarten classrooms. Kindergarten children who were just learning their letters and numbers and whose fine motor skills were not as completely developed functioned at a different level than second graders who had mastered the alphabet, were reading independently, and could solve basic math problems.

Many primary teachers used Accelerated Reader with their students, and reports on the benefits for students were positive. Both highly capable and less able students found the program motivating and challenging, and typically read more and "harder" books. Teachers expect the benefits to be deep and lasting, and they suggest that gains in reading scores will become evident in coming years.

According to teachers, Excel was used less often at the primary level for several different reasons. First, the highly interactive, hands-on nature of primary math programs that does not provide an easy avenue for integration. In addition, a number of teachers commented that they would need more training with Excel before they would feel comfortable using it in the classroom.

Figure 2



The following excerpts from teachers' journals give a sense of typical lessons at each grade.

Kindergarten.

- Having students work with partners in Word to type their names and other friends' names. The goal of this assignment was to teach them how to use some keyboard functions such as the shift key, alphabet keys, space bar and return key. This helped them understand the importance and usage of capital letters and spaces between words, as well.

- Having each student complete a "Family Tree" template in Word for our "Homes and Families" social studies unit.

- Creating an "ABC's in Our Community" book that is integrated into our communities social studies unit. In addition to writing and typing their sentences, they also drew pictures, which I then scanned into their PowerPoint slide show.

- Using the Internet to find and share a clip of Martin Luther King's "I Have a Dream Speech" so my students could hear his voice and words first-hand.

We are in the middle of a giant animal report that we are doing with our 6th grade buddies. The Ks picked out an animal and then learned how to import a clip art picture of that animal. They found out a number of facts about animals from both books, Encarta and several web sites. We are currently in the process of completing a Power Point presentation with our buddies on these animals. The 6th graders are of course doing much of the power point presentation but I hope that the Ks will be picking up a few basic skills that may help them making presentations in the future.

The kids have also been using the "Bailey's Bookhouse" software purchased by my school to reinforce their phonics skills; our math curriculum's software, which reinforces patterning and spatial skills.

First Grade.

- The children are writing stories by putting their ideas down on paper and then transferring them to the computer after they have had some editing help from their peers.

- We have just begun a cross-curricular unit on HOMES with a strong emphasis on reading, social studies and science. The children have been using KidPix to design buildings and have been visiting book marked websites . . . .

- I introduced a PowerPoint to my kids to practice "money skills" (they used the PowerPoint in "normal" view so that they could "drag" the coins over to each slide to make the amount asked for –

- We are using the digital camera to document the changes our caterpillars are going through.

The computers in the classroom are now being used about 3 times a week. I have helped the children learn how to manipulate the mouse around the screen. They can now switch between the different launcher screens (we use Macs in our school) to locate the program they are looking for to do a project or work on an activity. They can locate and use a math enrichment program that was put on the computers as well as our reading comprehension program known as Accelerated Reader. These are on a different launcher screen than MS Word. The children have used Word to transfer their writing from their spiral journals. Many of the

children now know how to find their work in their folder on the screen, how to save some of it with adult help, how to delete words in their writing, use the arrow keys, as well as return and make upper case letters. They can even control the volume with ease (unfortunately, we do not have headsets for each station) . . . A great deal of what I have done with the children involves helping them learn what the different functions mean and how they are used.

Second Grade.

- The students will be creating a PowerPoint presentation to share with their parents at an end of the year open house. The PowerPoint will include their own fairy tale, a map of the farm they created, and an Excel spreadsheet that shows their purchases for their farm.

- Reading/Writing- PowerPoint-After reading a book, students write about the author's work on PowerPoint "stickies" answering certain questions.

- Math- Excel-Place Value- In a teacher created template, students generate numbers and them put them in order to make the largest number possible and Excel lets them know if they are right or need to try again.

- Reading/Writing/Science- After researching students put information on an insect into a PowerPoint that has the same elements as a report and even create a quiz at the end for their viewers to check what they learned.

- Reading/Writing/Science- Students use teacher selected web sites to gather facts about a chosen insect. Also students do mini-reports, a partner group researches an aquatic insect and then presents a few facts to the class.

- Science- using a USB microscope to look at specific insects up close.

Students are now using the Internet along with library books to research simple reports. I select a specific site (such as enchantedlearning.com) and place a shortcut to the page I want students to use (such as the Enchanted Learning page on dinosaurs for our dinosaur reports). This saves students time in finding the information they need. I am also using the Internet to build background information for stories we are reading. We visited a site on blue whales (including film clips) when reading the book Dear Mr. Blueberry, collected our favorite recipes from cakerecipe.com when reading Hedgehog Bakes a Cake, and found a web site that allows us to design our own paper airplanes and print out the design when reading Mr. Putter and Tabby Fly the Plane. We are using the computer to publish students' writing (with lots of assistance from a parent volunteer). After the stories are printed, students illustrate them and they are made into class books. After I learned about using Microsoft Word to make Web pages, we completed a project in which students' planet reports were made into a collection of web pages, including clip art and a photo of each student (taken with my digital

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camera). This has not been posted on the internet, but, I have placed it on our file server, and included a shortcut to it on our classroom computers. Students enjoy opening the web pages and reading each others' projects.

While teachers had success with their curriculum lessons and projects, the most enthusiastic response was related to the benefits of their presentation hardware (Elmo). With few exceptions teachers felt that their teaching efforts were considerably enhanced when they had access to the camera and projector, and these perceptions grew stronger over the course of the year. The following quotes are representative of K-2 teachers' responses:

As before I am finding that I am using the technology in my classroom for instruction more than they are actually using it . . . (For example) when I introduce a new letter of the week. I take them to a web site children's dictionary where they look at all of the things that start with that letter. I first show it to them using my laptop and projector and then they use the classroom computers to explore on their own. The final task is for them to draw and label if they can pictures which start with that letter in their ABC books. They write their names, practice writing numbers and draw pictures and write using Kid Pix. They then can print these pages. I am going to use some of the number writing pages as part of an assessment for our progress reports.

My students LOVE the things we've been able to do with the Elmo/projector/laptop combination. The chance to have their work shown 6 feet tall on the screen is very motivating. We use it for sharing, writing instruction (to include letter formation where it is far superior to any other means of presentation), display and teacher modeling of writing and math . . . Parents are amazed and impressed.

The student reaction has been very motivating for me. My teaching seems to be more effective by far with ELMO and the projector. Each student can see exactly what I would like them to do just as if they were sitting next to me. ELMO also is a motivating factor for the students. Quality work is often shared with the help of ELMO. The students love it and try to do their best to earn the privilege. We are also using ELMO to share small books, which makes it so much easier for the children to see the detail in the illustrations, look for familiar words, etc. ELMO has also been indispensable during math for demonstrating manipulatives, during art for demonstrating specific techniques, and during handwriting for demonstrating proper position, pencil control, and letter formation.

It really struck me when someone asked to borrow my Elmo and projector for a project that they were doing and I became a little unnerved with the idea of not having them at my fingertips in my room. I had to tell them it was fine as long as I knew exactly when and how long that they would have them. These two pieces of equipment have really made an impact on how I teach. I use them when I give instruction all the time. Rather than an overhead or just holding up a paper I can show my students precisely what they will do for a project using their same paper

and they can all see it. I think that the visual learners in my classroom have benefited tremendously.

One teacher reflected on "Elmo's" influence on a specific student:

Since the introduction of the "elmo" and its partner projector,[the student] has written sentences that are more legible and include good ideas of interest to classmates. So where this writing activity had been one of problems and alienation for him, he is now motivated to participate in learning a skill considered necessary for academic success.

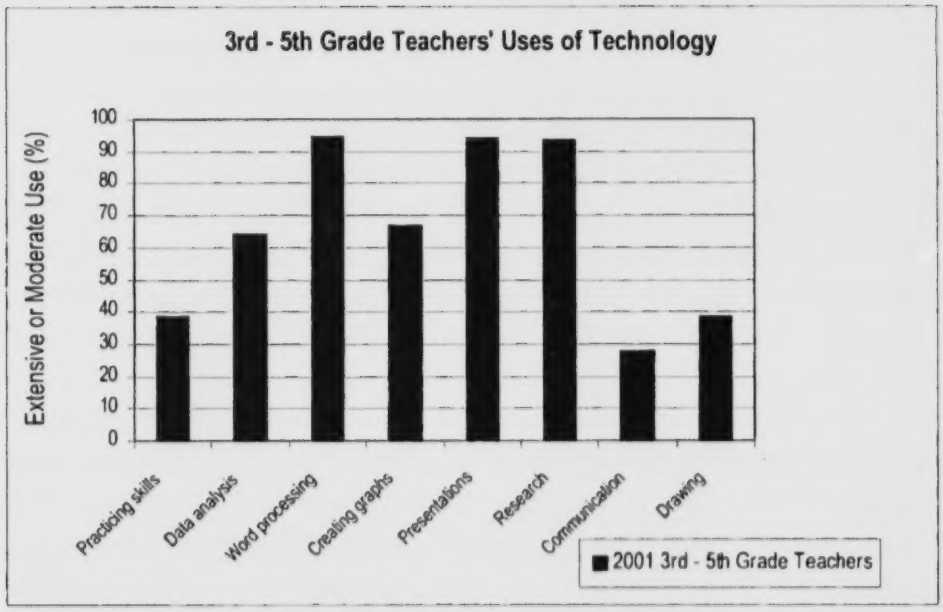
Generally, then, it was found that primary teachers utilized their technology frequently, both for instruction and for student activities. Typical student use included writing (Word, Kid Pix, Kidspiration, templates), and skill development (Reader Rabbit, Math Blasters). Teachers also used projection devices on a regular basis to share Internet sites, Power Point lessons, and to present student work.

Grades 3-5. In elementary classrooms, computers were used for writing (Word, Inspiration), for gathering information and studying current events (Internet, Encarta), and for developing reports and presentations (PowerPoint). Excel was valuable for data analysis and creating graphs, and Publisher, Clip Art, and Word Art were used for producing brochures, newsletters and book reviews. Use of technology in elementary classrooms is summarized in Figure 3. Teachers also used SchoolKit activities to develop conceptual knowledge and practice skills, and both teachers and students found ways to extend the curriculum with digital cameras and camcorders, scanners, document cameras and projectors. Like their primary colleagues, intermediate teachers and students were impressed with the teaching and learning possibilities offered by Elmo.

Journals entries from 3rd – 5th grade teachers provide useful examples of classroom use of technology.

Now that May is here and we have had our computers since November, I can look at our classroom and see that we have truly come a long way. Most of the students can sit up to the computer and independently open a word processing document, edit their writing using spelling and grammar checking tools, transfer files from Alpha Smarts to the computer and save their work in their desktop folder. They can access Encarta and the Internet for research searches. They have used Power Point and School Kit scaffolding units to demonstrate their knowledge and teach others about explorers and digestion. They are currently engaged in a more extensive biographical research project and they are using the computers, along with other sources, to research their topics, type up their reports and create a Power Point presentation to share their information with the class. The computers are tools that are used everyday to expand our communication possibilities, answer our burning questions and pique our curiosity.

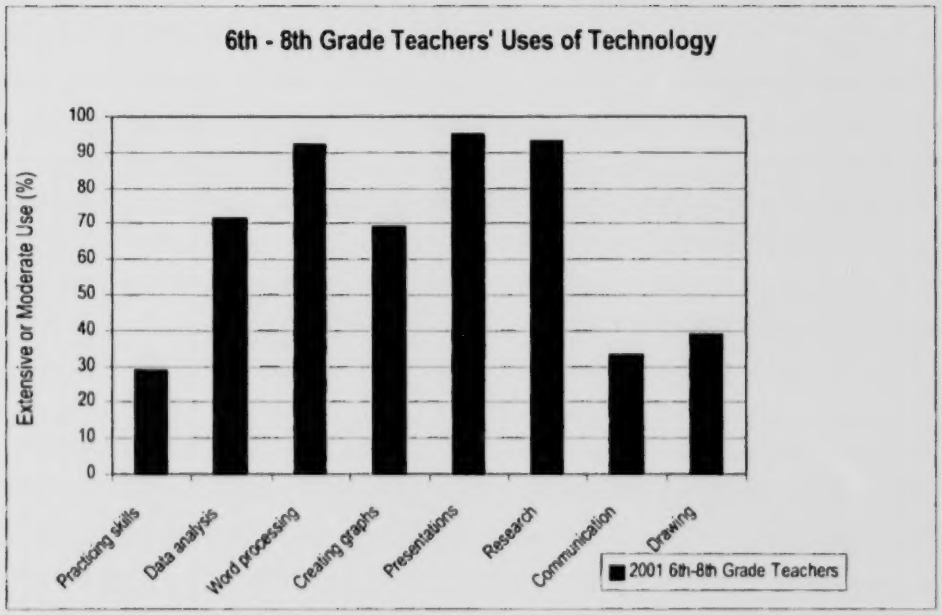
Figure 3



The last four stories in our reading series have been about weather. So we stopped and studied weather for a couple of weeks after that for our science project. Each child chose a weather pattern like hail storms, tornados, heat wave, etc. They then had to research that weather pattern finding out what causes it, where it is likely to happen, what to do to prepare for it, etc. and make a PowerPoint presentation about it including real pictures and sounds if they were able to find them. I had them stand next to the screen while their presentation was playing and do a weather forecast saying that their weather pattern was coming. I taped their presentations and they turned out great, they looked just like forecasters. Jeff Renner from King 5 is coming in two weeks to watch them and talk to us.

Grades 6-8. Middle level teachers used many of the same programs as their elementary counterparts (Figure 4). Word, Encarta and the Internet, and Power Point were used most often for writing projects, information access, presentations, and publishing. Digital cameras allowed students to enhance their projects with relevant photographs. Publisher, SchoolKit and Accelerated Reader were utilized in middle school classrooms as well. Use of Excel was more varied in the middle grades, where they analyzed data and constructed graphs and also made use of function and formula keys in math lessons.

Figure 4



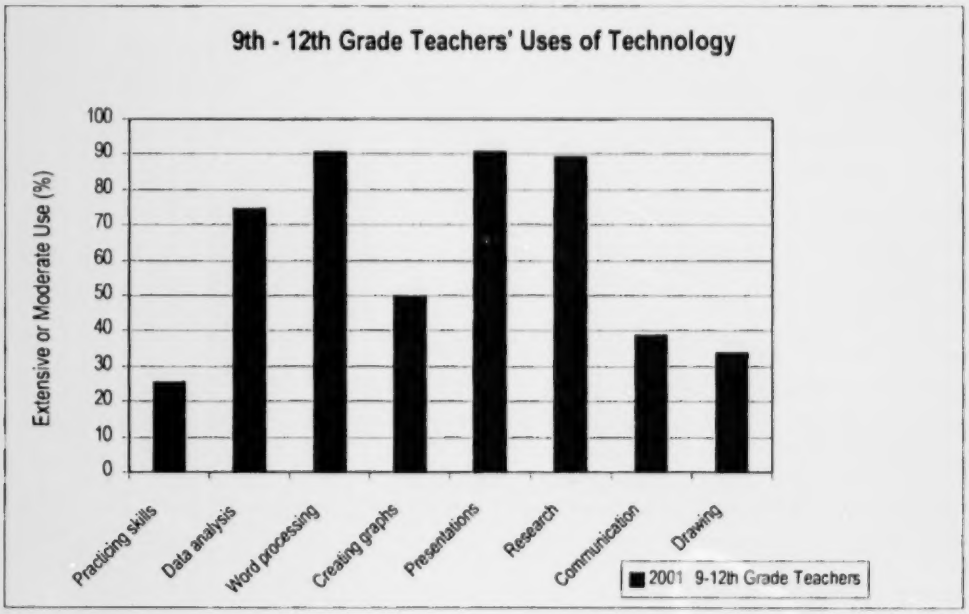
Middle school teachers shared the following examples of their integration efforts.

In 8th grade social studies, we are just completing a PowerPoint presentation about society in the Middle Ages. The students were broken into groups of 4, each student researching a segment of society (knight, priest, merchant, peasant). They did the research on the Internet, then created a segment of the PowerPoint presentation complete with pictures and background, then I compiled each student's slides into one presentation for each group. Now each group has to create a title page, edit for mistakes, put the slides in some sort of order, and then present the PowerPoint to the rest of the class.

Most recently, I designed a 6th grade unit on ocean resources, which uses MS Office to create various presentations. Students begin the unit by brainstorming ideas and creating a 5-page web site (using Publisher), which outlines the major types of resources humans get from oceans. In the next lesson, we read about energy in the oceans, then design devices to harness the ocean's energy. Publisher is used to make brochures to "sell" the devices. The final lesson deals with oil spills and keeping the oceans clean. After several experiments, students will create a PowerPoint presentation to show their experimental observations and conclusions, as well as researching commercial oil spill cleanup methods.

Grades 9-12. Like their middle and elementary school counterparts, high school teachers used Word, Encarta and the Internet, and Power Point most frequently (Figure 5). More high school teachers reported using PowerPoint for instruction and as a visual aid for classroom presentations and lectures than did lower grade teachers. Excel, SchoolKit and Publisher were used across all subject areas. Peripheral equipment such as digital cameras, scanners, digital video recorders and projectors were used in all classes as well.

Figure 5



Math. Many math teachers incorporated Geometer's Sketchpad into their lessons and commented on how it appeared to improve student's conceptual understanding of the material. Various SchoolKit lessons were also used in the classrooms, as was graphing software. Teachers found Excel effective for graphing and calculating formulas, functions, and probability. Math teachers also found ways to utilize the Internet, PowerPoint, Tesslemania, Green Globs and Accelerated Math.

Excerpts from high school teachers' journals give specific examples of integrated math lessons.

> *In Algebra 2, students used Excel and Graphic Analysis software to learn about exponential equations through exploration. [They] also recently used Geometer's Sketchpad's trace feature to explore the definitions of conic sections. In Algebra 1, students developed pamphlets to advertise the cell phone plans that they developed. They used Publisher to do this. [They] also used Excel to develop*

graphs in an effort to mathematically justify their cell phone plans to both the potential customers and to their boss. Students in all of my classes regularly use the computers to look up things on the internet and to type short papers.

My geometry students ...are currently working on a large two-chapter project that is done mostly using sketchpad. There are several investigations they must do to eventually discover the Euler line of a triangle. My Algebra students have used the program Graphing Advantage to graph and interpret several parabolas and lines. This has been a valuable tool for them, because it allows them to change certain numbers in the equation and look at what happens without having to go through the tedious process of manually graphing everything. My Pre Algebra students have used the computers to study translations and size changes. It has been a real valuable tool for them as it helps keep them interested in the subject matter as well as showing several examples in a short amount of time.

Social Studies. Social Studies teachers found Power Point and the Internet to be the most powerful programs for their students. The Internet was used primarily for research and for providing depth to their studies. Webquests were also useful in this regard as were Word, Publisher, Encarta and Excel programs.

Representative comments from secondary social studies illustrate typical integrated lessons.

I have integrated technology more often into my instruction. As a teacher I am using Power Point to present lessons and concepts. It seems to be looked upon favorably by students and it seems that they are remembering more about each lesson (they seem to be able to remember the power point slide and then to remember what it was about). Students are about to begin their final project of the year. Technology has to be an integral part of their project and most students are using power point, the internet, and other technology available to them to complete the final project.

Recently, technology in the classroom has been mainly on-line activities. With Modern World Problems, the students went to a web site through The Seattle Times connected to Middle East history. For World History, students have been researching the Renaissance artists and their works through web quests.

Science. As in other subject areas, PowerPoint, Excel and the Internet were used frequently in science classes. Word was also used for publishing research papers and lab reports. In addition to these programs, high school science teachers found Vernier probes, SchoolKit, and Publisher to be worthwhile. A student to computer ratio of no more than 4:1was most effective for using the probes, they discovered.

This year I'm doing a MARS2030 Project with my freshman Earth Science class. Having the technology in the classroom has allowed them to do research on up-to-date events with NASA as well as learn about the planet in general. One team

of "mission specialists" put together a power point presentation for one component of their task and it was great! I believe technology fosters initiative.

Geology students are working on a GRASP project on plate tectonic disasters. They are using a shareware program on seismology and volcanism, various internet sites and will put the whole thing into PowerPoint. Physical World students used the motion sensor to measure the speed of battery powered cars, and they are working on a final project on the geology of the National Parks. This involves using Excel, PowerPoint and topographic map software. They also wrote memos about weathering and erosion using Word.

Language Arts. Not surprisingly, language arts teachers used Microsoft Word, Power Point, and the Internet regularly in their classrooms. Along with Word, Publisher was valuable to students in creating final products. Students created PowerPoint presentations of book summaries and project reviews as well as to enhance oral presentations. The Internet was a valuable tool for gathering information for research papers. SchoolKit and Webquests were used less often in language arts classes than in other subject areas. Many language arts teachers began keeping electronic portfolios for their students to show growth over time and for assessment purposes.

I worked with the teacher of our computer technology classes to create an integrated project. My students wrote fairy tales and worked with a partner from the computer class to publish their work. Publications included clip art, original scanned art, photo draw, and various fonts and enhancements available through the Internet and Microsoft programs. We will use the video camera to film student rap songs and the digital cameras to enhance student created PowerPoint and video productions.

Almost every day now, my students are doing research on the computers. They are either searching the Internet for sources for their research papers, finding a current event for a writing assignment, or finding support for their persuasive speeches. They are in constant use. Also, we just began work on their final presentations, which will include a power point component.

Use of Technology in the Classroom: Year 2

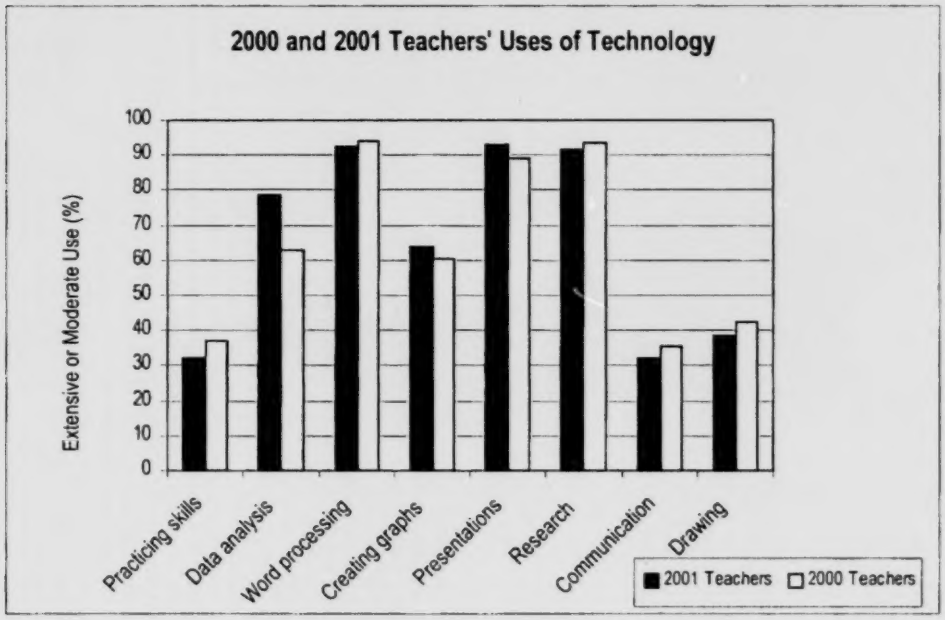
Journal responses and survey results from second year TLP participants indicated that they used technology in many of the same ways as first year teachers (Figure 6). Second year differences were more often related to attitude and experience than to technology use. Survey results indicated that in both first and second year classrooms, students used the computers most often for word processing activities, presentations, and research. The technology was used less often for skill practice, communication or art activities.

Essentially the integration of technology into my classes has been consistent with last year. Geometry classes use Geosketch Pad. Student Fair projects were very popular, as students used PPT productions to demonstrate their learnings. One school kit unit has been used. We chose not to subscribe to school kit, because our tech backbone was not strong enough, the site too awkward, or our staff not experienced enough – probably it was all three. TI-83 calculators are still the technology tool of choice in the classroom. I've done some very effective PPT lesson presentations. Although not difficult to prepare they do take more time than the standard white board presentation.

I am doing many of the same things I did the first year—Using AlphaSmarts for word processing; Accelerated Reading; Accelerated Math; Research (Groliers & Encarta); Power Point Class Projects; Classroom routines (ordering lunches, graphing weather); Writing projects.

This year the integration of tech into our curriculum looks much like it did last year, as I integrate technology, literacy, and social studies or science. Fortunately, my class schedule for fifth grade provides a large block of time for literacy, so our writing projects focus on a topic from either social studies or science, and involve research from the Internet, Encarta, Electric Library, and traditional forms of text. Students have also used technology to create graphs and tables to explain their math results from surveys they also created using tech.

Figure 6



Experienced teachers were consistent in reporting that the integration process was less stressful during the second year than the first and that their planning efforts were less "forced." They felt more confident in their abilities, were more willing to explore and take risks, and they were more apt to give students a greater degree of independence when using the computers. During the first year, teachers often had ideas for projects that they believed would be valuable for students, but often did not have the confidence, the time, or the expertise to implement them. During the second year they were much more likely to attempt such projects. In addition, second year teachers found it easier to focus on student outcomes and the curriculum rather than on the technology (learning new programs and fixing glitches). Their comments are helpful in clarifying these findings.

> *My efforts have been different this year because I can do more. I am no longer in the process of trying to figure out how to integrate technology. I can focus my attention more on the curriculum and provide more challenges for my students. I am continuing to learn more about the use of technology and love trying new things out with my students.*

> *Last year I worked very hard to "come up with" activities and lessons with which we could use the computers. I felt a lot of pressure to make sure I was using the computers well. From the start of my first year, I wanted to integrate technology, and make sure that it was not an "add-on", but my frustration was that with seven and eight year olds, I always had to do a lot of pre-teaching of computer skills. Technology was somewhat cumbersome to integrate. This year I have tried to design projects which incorporate technology when it is a "just-right" tool, or when I have a new computer skill to teach, or when the use of technology is a logical progression/extension in the learning process.*

> *My integration efforts are a bit different this year. I find integrating technology is similar to last year, but more in-depth. I am also more confident in trying things with the students that I would have not felt capable of doing last year. I guess I am more relaxed. And as the students have become more sophisticated in their use of technology, I have to become better, too. And I know I have a long way to go. I harbor no illusions as to my capabilities.*

> *The difference between this year and last year is that the integration of technology is almost second nature for me. I am always aware that in my planning with my teammates or alone technology will play a major or minor part of the unit. Because this is also the second year, my computers were up and running on day one. What a difference from last year! I have also learned how to do much of my own troubleshooting and rarely need to use the tech guys in my building. My district has offered Power Point, Word, and Excel classes. So far I have taken Power Point and Word. I am no longer scared to death of technology – I was one of those participants that panicked when I opened my laptop at training. A far cry from last year, I feel as if I can help others around me.*

I have been able to do more in less time because I have reorganized my program to include regular use of computers. The enhancement that technology brings to my old units is great. I am excited all over again! Having the computers this summer gave me planning time that has definitely paid off this year! There are still topics such as the scanner that I swore I would have mastered for this year and it just hasn't happened.

What a difference a year makes! It is so hard to believe that my introduction to the Teacher Leadership Project was just 18 months ago! I suppose when you start by crashing your laptop while trying to get it out of the box (true story!), there's no place to go but up!

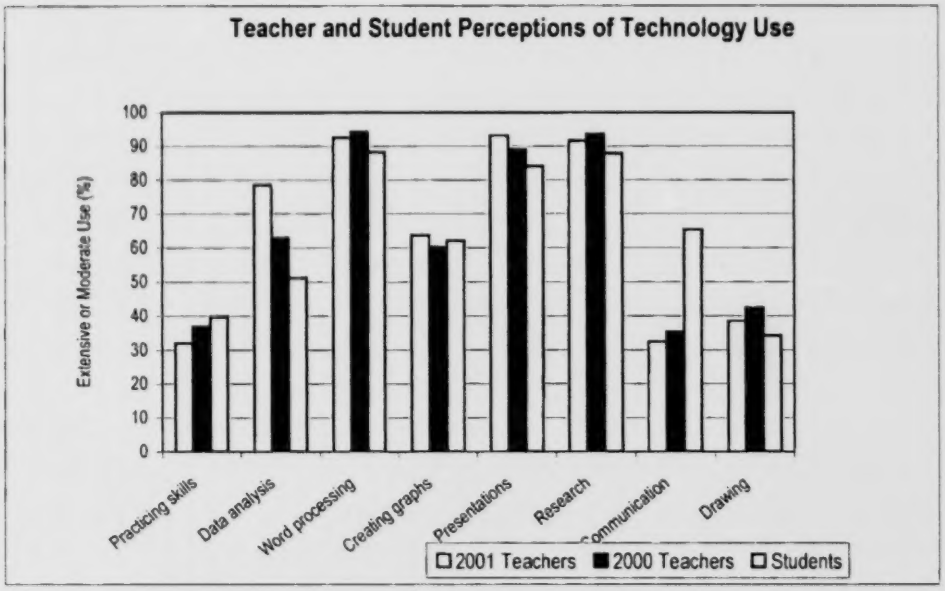
Some teachers reported that the process was at least as difficult during the second year as it was during the first. In most cases this was due to either a change in grade level or the fact that they had a class of students with low abilities or low technology skills, although not always. In many ways, for them the second year was not unlike that of a first-year participant.

I started out slower this year due to the fact that I had the non-readers in second grade assigned to my room. As a result I don't have as many helpers in the classroom for reading directions and trouble-shooting problems . . . Three of the students I lost so far this year were helpers. We've made progress with the reading and I'm hoping computer activities will go more smoothly the second half of the year. Publishing has required more final editing and adult help and usually takes more time . . . Not as many of my students have computers at home . . .

I've discovered that this group of students has very little technology skills. Most of my students came from a one Macintosh computer classroom and needed to learn the very basic skills such as how to turn the computer on and shut it down in the evening. (I have all Gateway computers in my classroom.) I spent the first month on word processing and how to use the various tools that Word had available to them. It was extremely difficult because I also have an overloaded classroom with 29 students.

Student Perceptions. While student perceptions of classroom technology use were generally similar to those of their teachers, there were some interesting discrepancies as well. For example, 79% of first year teachers and 63% of second year teachers believed that technology was used a moderate or extensive amount of time for data analysis and solving problems, yet only 51% of students believed that to be the case. In another instance, 32% of first year teachers and 35% of second year teachers believed there was moderate or extensive use of technology for communication while 66% of students felt this to be true. Figure 7 provides a comparison of teacher and student perceptions of how technology was used in the classroom.

Figure 7



Use of Technology in the Classroom: Years 3 and 4

While clear patterns have emerged to describe first year integration efforts, less is known about the long-term classroom uses of technology. In an attempt to understand how the integration process develops over time, a sample of third and fourth year TLP participants were contacted and asked to discuss their experiences. In-depth interviews provided valuable insight regarding the ways in which they used technology in the classroom.

After at least two years in the Teacher Leadership Project, teachers reported that they used much of the same technology that they did during their first year, at least in terms of programs and applications. For example, Word, Excel, Power Point, Encarta and the Internet were still used on a regular basis, although experienced TLP teachers were more comfortable with the various programs and applications, were more knowledgeable of the finer points of the programs, and were more willing to experiment and try new projects. Most had made changes to their teaching style since beginning their integration efforts, such that their classrooms were more student-centered and oriented towards project-based learning. Finally, several teachers noted that they did not spend as much time teaching technical skills to students as they did the first two years. Instead they were more likely to let students explore the technology and learn skills by trial and error.

A few teachers experienced deeper changes in how they approached teaching and learning. It should come as no surprise that after three and four years of infusing technology into the curriculum, most (but not all) teachers were generally much more comfortable with the process. They recognized that many of their initial efforts were "forced" in that they "looked for as many ways as possible to fit technology into the curriculum." Experience has allowed them to step back and focus on the curriculum rather than on the technology. As one teacher observed, "My focus is now on the curriculum. I don't look at it like 'I have Publisher, how can I use it?' Now I am more likely to say, 'I am teaching the Revolutionary War' and then I'll see if technology has a place and if it will enrich the unit." These deeper changes in attitude and approach do not happen quickly, however. Teachers in their first year of the TLP are typically excited and motivated to use technology for improving teaching and learning, and they often get so involved in the details of integration that they have little time (nor do they have the experience) to reflect on the change process. Interestingly, comments from these third and fourth year TLP teachers suggested that the potential to significantly transform teaching and learning is related to this change process. As one veteran teacher stated, "[First year teachers should] be prepared to change both their philosophy and their attitude. They will have frustrations and discomfort . . . it is all part of the process. I went through a change . . . I had to go through a change process. You can't just skip the learning process. Like in the beginning when I constantly had to think about what I was going to do with the technology. I couldn't just skip ahead to where I am now . . ."

Veteran teachers also found balance in their integration efforts. While first year teachers often feel an obligation to use the technology "all day, every day," second year teachers come to realize that there are some lessons where technology is appropriate and others where it is not. The curriculum is the determining factor in whether or not technology is used for any given lesson, and teachers are not bothered if the computers go unused for an hour or a day or even for a few days.

These findings support researcher's claims that one of the critical conditions to successfully using technology for the improvement of teaching and learning is teacher expertise. Certainly change starts with the individual teacher, who catches the vision and is willing to take risks (Earle, 2002, p. 10). Still, "Technology generates a glut of information but it has no particular pedagogical wisdom – especially regarding new breakthroughs in cognitive science about how learners must construct their own meaning for deep understanding to occur. This means that teachers must become experts in pedagogical design" (Fullan, 2000, p.582).

Observations. Classroom visits provided a number of opportunities to see technology being used by third and fourth year TLP teachers and their students. In several cases students were working on individual projects, including Power Point presentations, keyboarding practice, word processing language assignments, and searching the Internet for information while in other classrooms teachers were using technology to present lessons. In one instance students presented their Power Point reports to "guest" students. Several points are worth noting regarding the observations. In terms of student use, most appeared motivated to use the computers although their

keyboarding skills varied. Aside from keyboarding, it was clear that most were comfortable with the computers, maneuvering in and out of programs with relative ease.

In terms of content and approach, the lessons looked similar in many ways to those one might see in traditional classrooms. For example one class was solving math problems, a typical activity in many classrooms. The only difference in this case was that the computer generated individualized worksheets based on a student's past performance. After the problems had been scanned and corrected by the computer, a new worksheet was generated, again individualized for each student. Students did not appear particularly motivated to do their work, and aside from the immediate feedback they got from the computer, there was little to distinguish this lesson from a traditional math practice lesson. In another lesson, students practiced computations with fractions while the teacher used a website to demonstrate equivalent fractions. Students' answers were checked with the website answers which allowed them to see their mistakes immediately. Their technical skills were impressive in many cases, and it was clear that students were generally motivated to use the computers. Beyond that, it was difficult to determine whether the educational experience of the students in these classrooms was changed so very much by the addition of technology. It should be pointed out that the visits were only a brief snapshot of what happens in these classrooms over the course of the school year although experience suggests that snapshots are not totally unrelated to typical practice. Perhaps the motivational factor was justification enough for using technology and maybe the potential of the technology was realized to a greater degree in other lessons. However, one final example provides contrast.

As part of a unit on "Flight", students were researching the various parts of a plane to determine the function of each part. In groups, students used a NASA website that had an interactive diagram of a plane. As a student selected a specific part of the plane and clicked on it, the part would move and information was provided on the function of that part. Each student had a role in the activity (controlling the mouse, taking notes, etc.), and at the conclusion of the activity, students were to create a model of a plane with working parts. Students were engaged, the purpose of the task was clear, and the technology offered an experience beyond what could be accomplished with traditional resources. It may be useful here to re-state Pierson's observation on the relationship of pedagogical knowledge, content knowledge, and technical knowledge.

> A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge . . . unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore, is likely as rare as expertise (Pierson, 2001, p. 247).

Summary

Are teachers using the technology as intended? Although practices differ based on several variables such as grade level, teacher experience with integration, technical support, students' technical skills, and classroom demographics, evidence indicated that

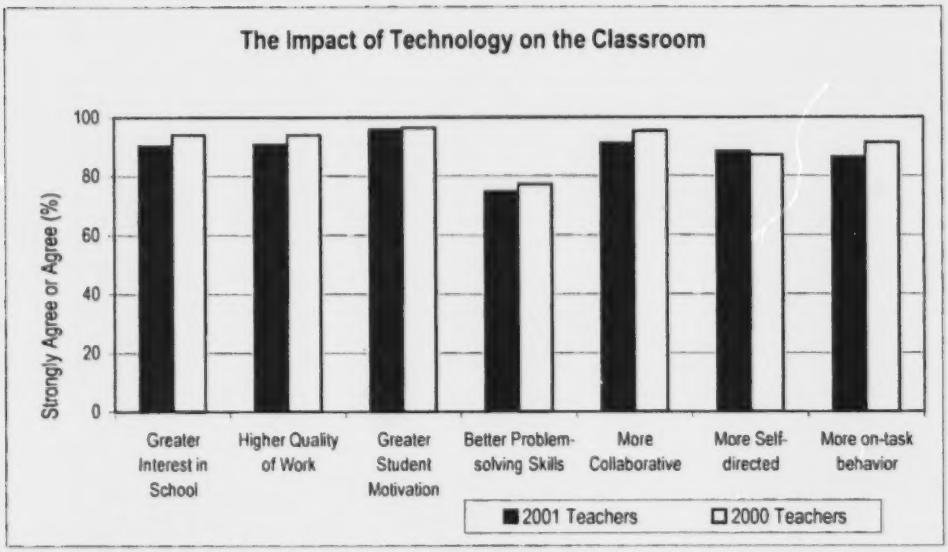
teachers' efforts were serious and well-intentioned. As findings from previous evaluations have shown, first-year TLP participants face numerous challenges in implementing an integrated curriculum, while second, third and fourth year participants find the process to be less stressful and generally more productive. Whatever their level of expertise, however, TLP teachers take the charge of "meaningful integration" seriously and do whatever they can to design and facilitate powerful learning experiences for their students. It would be surprising if all TLP participants reached a transformational level of integration given that the transformation of learning depends not only on access to technology but on teacher expertise and favorable conditions (administrative and technical support, for example). That said, there is reason to believe that TLP teachers' integration efforts have been enormously successful in strengthening and enriching the teaching and learning experience.

Evaluation Questions: *What effect has the training had on teaching and the classroom? What has been the longer-term impact of the program on the classroom and the school?*

A majority of TLP participants reported that their training had a significant impact on their teaching and their classrooms. This was true for nearly all teachers, regardless of the number of years they had been in the program. It was their perception that motivation, interest in school, on-task behavior, problem-solving skills, ability to access information, and collaborative skills were some of the important ways in which students benefited from an integrated curriculum. Teachers also suggested that the quality of work was better when students had access to technology and that technology enhanced the learning experience for special needs students. For many TLP participants, integrating technology into the curriculum changed their approach to teaching as well. Their classrooms were more student-centered, and a greater emphasis was placed on projects and self-directed learning. Most teachers found their role shifted, at least to some degree from "director of learning" to "facilitator of learning," and they enjoyed participating in academic exercises along with their students. Figure 8 provides information on teacher perceptions of the positive impact of technology on the classroom and on student learning.

Motivation. From the beginning of the year, teachers found that the biggest impact of adding technology to the classroom was increased student motivation. Students were willing to do projects using the computer that they normally would have avoided such as editing papers and doing research. Part of the motivation was due to the novelty of the computers and part was due to the ease of the writing process when they used computers. While students were often reluctant to edit and revise their written work when done with pencil and paper, the same tasks were generally done without hesitation when they could use the computer. The end result was improved writers. As the year progressed, teachers continued to see improved student motivation and more on task behavior. They also found that more students completed more assignments. Teachers stated that each of these factors had a positive impact on the classroom and on student learning.

Figure 8



Second, third and fourth year TLP teachers agreed that student motivation was one of the most important changes to teaching and the classroom that could be attributed to the addition of technology. When they were in a technology-rich classroom students were more positive in their approach to schoolwork in general, and to research and writing activities in particular. The following accounts from teachers are typical examples of the motivating impact of computers.

> *Students are on task more; motivated to work on their computer projects and do online research; excited about each new project; and writing more (minimum of 2 pages on essays). Some students want to write as much as 5 pages when using the computer for word processing, rather than writing by hand.*
>
> *Student motivation is by far the greatest benefit. The students are so much more willing to do a project or research with the computers. The 6th grade teachers have commented that they see a difference in my students that they get.*
>
> *KIDS ARE SO ENGAGED!!!!! I love that! They LOVED doing the Power Point and the Oceania investigation, they stayed in at lunchtimes, came in after school, some even before school.*
>
> *I believe the increased excitement that the students have for learning is assisted by the use of technology. They think in terms of the Internet for research. They are excited to write using word. Students who are difficult to get work from will produce if given the chance to use a machine.*

Students are still more willing, in fact eager, to write using a computer. Students' writing shows more thorough revising and editing. Students strive for higher quality because of the potential to produce attractive and "correct" work using Microsoft Word art and editing tools. The students continue to be motivated to do their best work since they are excited to share their work with the class using the Elmo and projector.

Quality of Work. Both first year and veteran teachers were convinced that the quality of student work was much improved when technology was available to students. Many assignments exceeded teachers' expectations and were a source of pride for students, particularly for those with poor handwriting or artistic skills. According to teachers, the "playing field was leveled" when students were able to produce professional looking products regardless of their ability level.

I have seen an incredible reaction from the students, they are so excited to use the computer for research (Encarta), and to use the computer to create a professional looking document, and their self-image improves greatly, as they feel such success.

I have found that students are excited to produce more when their final product can have a "published" look about it.

They feel like experts using tools that are used in the work force. They are able to produce professional looking presentations and are eager to share findings.

Research. Nearly every teacher felt that one of the most important benefits of having computers in the classroom was information access. Many pointed out that their school libraries lacked current and relevant printed materials, and thus computers provided students with research opportunities that were otherwise unavailable. To be used effectively, however, teachers discovered that students had to be taught how to do efficient and effective searches, and many teachers found it necessary to teach and reinforce this skill throughout the school year. Once students understood the power of an effective search, they found a whole new world of information available to them. One of the benefits of using the Internet for research, according to teachers, was the need for students to analyze information to determine not only its authenticity, but also its relevance to the lesson or task. For this reason, and because of the sheer amount of information available, many teachers suggested that their students were learning more because of their immediate access to information. And even though primary students were less able to do information searches on their own, they saw the benefits of immediate access through their teacher. All in all, TLP teachers reported that one of the most powerful elements of a rich technology environment was the fact that students had immediate and independent access to a world of information.

If anything, experienced TLP teachers were even more convinced of the educational benefits of the Internet than were first year participants. They reported that

the Internet gave students connections to the real world that could not be duplicated with textbooks or other traditional information resources. The following are powerful examples of how the Internet was used to enrich and extend student learning.

One small example of the power of the Internet is access to primary sources. The Zimmerman telegram (an intercepted communiqué between Germany and Mexico that helped push us into World War 1) is on the Internet in coded and decoded form. Access to this letter not only helps drive home the concept of primary sources but also brings alive one of the factors that led us to World War 1. As a follow up another site has ready-made forms available for analyzing primary sources of every conceivable form.

Technology, specifically the network, changes everything about how we work. Individuals and small groups can branch off on webquests and interactive collaborations with their classmates or with students around the world. It means that the classroom will be diminished in importance while direct instruction will be delivered in ways which can be accessed repeatedly and on-demand. Okay, maybe I don't have the setup and skills to completely realize this vision; yet, those who do not see it will find themselves left behind.

Where I have seen the biggest change has to do with researching information for a project. Because I use technology as an enhancement but not a replacement for researching a topic, I do not see them become as detached from an assignment because of a lack of reference material. There seems to be more energy towards completing an assignment because the information is there. I feel that some of the excitement is because they can access information quickly...this helps those with short attention spans. Because they can gather the information quickly, I find I do not have to jump-start students as frequently. They become very excited when they can share information with their classmates that they have found independently.

My classroom is more like the real world. When we need info, we go to the computer. When we need to type something, we go to the computer. When we want to explore an interest, we go to the computer. This is what life is like for people who live in a technology dependent world. Students have greater access to information through the computer. If we did not have the computers, they would be dependent on a few books from our library, and a set of encyclopedias. There is greater collaboration and sharing of information. I often hear..."Come and look at this," and "That's cool, what website is that on?"or "I like that. Can you show me how to do that too?"

My students know that new information is at their fingertips. They love it when I don't have an answer to a question because then they can research it on the Internet and share their findings with the class and me.

Access to research when you need it is valuable and the students continue to just pop in and out when they are working on a project. The students are way ahead of me and continue to teach me in this area. I just have to remind myself to keep up with their times. For example, I recently introduced a Sacrament Project and typically, I introduce the material, take the students so far, give them information about what components are necessary to complete the project and them put out the resources that I have to assist them. This year, over 75 percent of the students went immediately to the Internet for assistance. They researched, found good sites and went to work. As I said, I just need to remember to be open to their growth.

Curriculum Enrichment. In addition to student use of the Internet for research, teachers were able to access many on-line learning sites to extend and enrich the curriculum. The Smithsonian website, for example, offered students the opportunity to "visit" landmarks and institutions they might otherwise not see, and many classes went on "virtual fieldtrips" to places all over the world. Students were able to dissect animals using virtual technology. Additionally, teachers used websites such as Marco Polo, PBS, enchantedlearning.com and littleexplorers.com to find information and lessons that supported their curriculum. Homework help sites and "ask a scientist" sites were among many that teachers and students accessed regularly.

The virtual Lewis and Clark museums have actually been a great success. I have never seen kids so interested in doing research and writing reports. They actually ask to do Social Studies. This project was true integration. We had reading, writing, research skills, cooperative learning and technology all rolled into one. My students learned that there is more than one place to get information, and that books are an equally good source for information. I know my students learned more and will remember more about what life was like and the challenges Lewis and Clark faced than they ever would have without the Virtual Museum Project.

Cooperative Learning. While the 4:1 student to computer ratio often proved challenging to manage, it nevertheless provided valuable opportunities for student collaboration and cooperation. Both journal responses and survey data indicated that the development of collaborative skills was one of the most positive outcomes of technology integration. And the tendency of students to work together was not limited to time spent at the computers; teachers observed a transfer to other classroom situations as well. Students were willing to share computers and printers, noted teachers, but more important was the degree to which they shared their knowledge and skills. Whether they were doing research, working on projects, or doing presentations, teachers sensed that students were learning more because of their collaborative efforts. There is some evidence to support these perceptions. Researchers have explored the relationship between the use of cooperative learning groups and student achievement, and evidence suggests that the results of such groupings can be positive. Johnson & Johnson (1989), for example, found that students in cooperative groups learned significantly more than those in either competitive conditions or in individualistic conditions, and Slavin (1989) found a small but positive effect on student achievement when students worked in cooperative groups.

The willingness of the teachers and students to be collaborative learners has been a very important part of making the integration successful.

Most of all, my classroom this year is truly a collaborative place because of technology. My students have learned not only how to share information but how to share with others their expertise in certain areas. With technology each child can learn something tangible that they can teach to someone else. Their excitement to learn and share is even more evident because of these computers in the classroom.

Writing. Another area in which teachers saw technology-related changes was in student writing. Results of previous evaluations have shown that students tend to write more and they are more apt to edit and revise their work when they have access to a computer. And as one teacher noted, "The more students read, the better they read. And the more they write, the better they write." The document camera encouraged their writing efforts even more. Students enjoyed sharing their work with the class on the big screen in front of the whole class and took extra care in perfecting it when they knew they would have an audience.

. . . I have also noticed that when the children are typing using MS Word, they are more aware of spacing, punctuation, grammar, and spelling. They are actively engaged in wanting to edit and self-correct their work. I truly see technology enhancing their learning, and I say this even though I have not even begun to utilize all that I learned this year.

. . . I also see increased motivation when the kids know they will publish their work using word processing or graphing software. They take the time to edit and produce quality work when they know their work will be made into a hard copy and shared with others. When the students know they will be sharing their work on the Elmo/projector they take their time to make it legible and neat. They also take more time to understand what they are doing.

When they have typed a draft on the computer, students seems much less reluctant to go further with the revision process when writing, especially longer pieces. I've seen many of them realize how easy it is to make changes and therefore look a little more closely at their own writing in order to add more description, details or make ideas clearer. Papers have less spelling errors and students with some physical writing challenges are better able to get their thoughts and ideas down on paper.

This is the first time in the last two years that I can say that my students are better writers because of technology, but I believe it is true. My fourth graders were given the opportunity to learn keyboarding on a classroom set of Alpha Smart computers. The keyboarding skills that they have picked up (which are still not real great for some of them) have made composing and/or editing on the

computers a different task than it was two years ago. Revision has always been a difficult thing for 10 year olds to do, but now that they are able to use their word processing skills, it no longer seems such an obstacle. Students are more willing to revise and edit pieces when they know that they don't have to rewrite the whole thing over again.

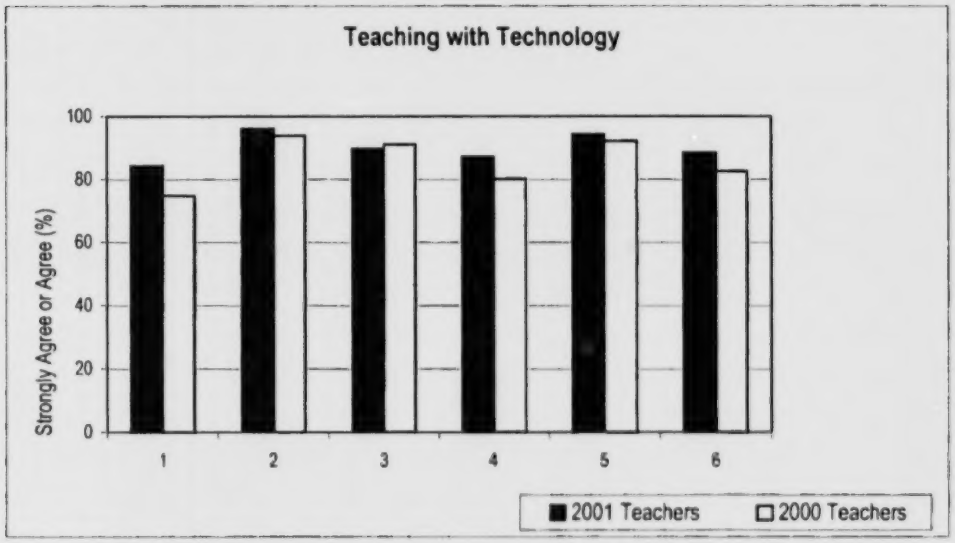
I have also been fortunate enough to have a document camera now. I love it! I have had students give speeches where they can show how they have analyzed a piece of writing by using the boxlight and ELMO. It is fantastic, and the kids enjoy using it.

Teaching and Learning. Based on their experience, on observations, and a limited amount of test score data, many teachers believed that students were learning *more* and learning *differently* in technology-rich classrooms. They cited the tendency of students to read more, to write more, to discuss and collaborate more, and to independently look for information as evidence that they were probably learning more. Results of the survey provided insight into these perceptions (Figure 9). Ninety-five percent of first and second year TLP teachers indicated that student learning was improved through technology integration (Item 2) although they were somewhat less certain about the *necessity* of technology for achieving their goals and objectives (Item 1). Other studies have produced similar findings. For example, teachers that participated in the Ameritech program at Kent State University suggested that their students' higher order thinking skills and test scores were improved when they learned in a rich-technology environment (Tiene & Luft, 2001-2002, p.4). In another study researchers reported a "minimal but positive effect on student acquisition of higher order thinking skills" resulting from technology integration (Hopson, Simms, & Knezek, 2001-2002, p. 114).

In their journals, teachers shared their thoughts on the changes to teaching and learning.

Using technology as a tool to enhance learning experiences provides students with a rich learning environment that integrates reading, writing, listening, speaking, math, social studies and science. Students are more engaged in the learning process while using technology than they are using more traditional tools such as books, paper and pencils. Because students are more engaged, their learning experiences and understanding are deeper.

Figure 9



1. It would be difficult to accomplish my learning objectives without the technology.
2. Technology integration in my classroom improves student learning.
3. Technology integration has changed my role as a teacher.
4. Students in my classroom focus on learning, not on the technology.
5. I can easily explain how technology improves or enriches any lesson in which it is used.
6. Integrating technology into the curriculum is a natural component of my teaching.

It is difficult to give specific evidence that they are learning differently and/or more. My evidence would be my personal observations. Students can easily search, locate and process relevant information for a variety of topics. They have demonstrated through their questioning that they use critical thinking skills to determine whether or not a source is valid. It seems that students compare information from sources more critically, rather than assuming that something is correct just because it's printed . . . Students' educational experience is better in several ways. The first is the access to information. In addition, students have a wider variety of methods to demonstrate their knowledge. In more open ended projects my students choose from using PowerPoint, Excel, hand-made posters, dioramas and essays. Students have become more adept and choosing projects that fit their learning style best. They are not intimidated by unfamiliar or challenging situations. Today a student found a video that fit perfectly with her project and learned to download the video as well as the necessary software to view the video.

We recently completed a Levels Test for second grade students at our school. My students scored very well! I have four special education students as well as five

more students who qualified for special help in reading. I was very pleased with their test results. Of course, I cannot say that this was only because of the technology assisted learning they have been exposed to, but perhaps it was in part part of the reason.

Role of the teacher. Just as the classroom and student learning are being changed by technology integration, so too is the role of the teacher being changed. TLP participants reported a number of ways in which technology has impacted their work. For some, their participation in the Teacher Leadership Project has kept them from leaving the profession or retiring while others said that it made the job more exciting and fun. Findings from the Ameritech study were much the same, with teachers reporting that they "spent less time in front of the class and more time working with small groups or individuals" (Tiene & Luft, 2001-2002 p.3). "It fostered a shift in teaching style from 'sage on the stage' to 'guide on the side,' and in fact one teacher reported spending more time learning with the students than teaching them" (p. 3). TLP teachers had the following comments about the changes they experienced.

I have a renewed enthusiasm for teaching. I'm having more fun . . . I'm no longer content with the teacher manual.

This grant has kept me in the classroom. The computers focus the kids, I have less behavior problems, the students are excited about learning.

A number of teachers felt their instruction was more effective when they had access to technology, and repeatedly they noted that more of their time was spent facilitating learning rather than directing learning. Second, third and fourth year TLP participants saw similar changes to their teaching role. In addition they were more likely than first year teachers to refocus their curriculum planning efforts on student outcomes. In the case of second year teachers this may have been due in large part to their exposure to the Understanding by Design framework.

I like that a visitor can walk into my classroom and have to work to identify me. I am usually found sitting among my students posing questions and prodding them into more challenging directions. I'm not the sage on stage . . . Students are the reason that I am in the classroom and they must be the center of my classroom. Now, instead of lecturing at them or presenting them with worksheets (two practices that I believe lead to lazy learning), I am more inclined to give them a blank piece of paper and pose some broad question. They get to wrestle with ideas and concepts. They get to learn!

My role has changed in that I don't just stand in front of the class and lecture them and expect them to take notes and memorize something and spit it back to me. I am able to interact more with the students on an individual or group basis. I've gotten to know my students strengths and weaknesses better and have been better able to help those that are struggling students.

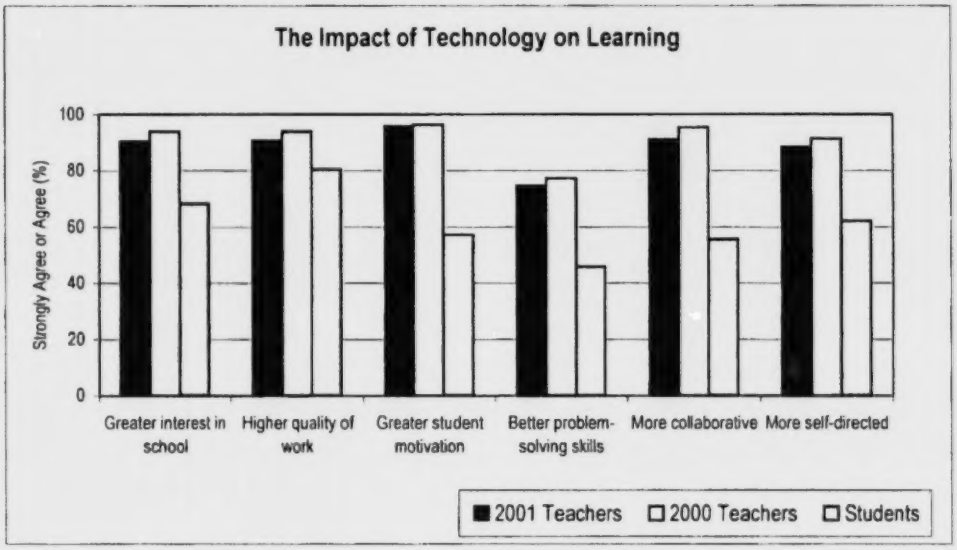
I think this has enabled me to be more of a facilitator of children's inquiry, as well as a teacher of content, using technology when appropriate and efficient. My focus has shifted to looking at the deeper processes and skills children need to meet state standards, to support them as life-long learners and world citizens.

Additional Teacher Perceptions. While teachers reported several important ways in which the integration of technology benefited students, there were other areas in which they were either unsure or unconvinced that technology made a difference. As an example, teachers were not certain about the influence of technology on traditional test scores(31 % unsure or no difference), parent support (35%), or attendance (68%), and 34% reported that lesson planning was more difficult in an integrated environment.

Student Perceptions. Survey results indicated that students generally agreed with teachers about the impact of technology on the classroom, although their responses were somewhat less positive than teachers. For example, 81% of students and 92% of teachers strongly agreed or agreed that work was of higher quality when students had access to computers. And yet while 93% of the teachers felt that students were better collaborators in a technology-rich environment, only 56% of students found this to be true. For their part, students reported that the areas most positively affected by the addition of technology were the quality of work (81%), the accuracy of their work (79%), the amount they learned (74%) and their interest in school (68%). They were not as convinced that computers had a positive impact in other areas. Slightly over half agreed that they were more motivated to do schoolwork when they had access to computers (57%) and only 46% agreed that their problem-solving skills were improved because of the availability of computers. A comparison of teacher and student perceptions is presented in Figure 10.

Impact of TLP training on the school. An analysis of journal responses revealed several ways in which schools were influenced by a teacher's TLP training and experience. In some cases teachers said that their involvement with the TLP led to a greater school-wide interest in "moving toward technology," while others found that the in-services and technical support they provided at the school level helped create a more positive attitude towards technology. Some schools applied for Gates reinvention grants based on a TLP teachers' experiences, and certainly more teachers applied for TLP grants when they had one or more practicing TLP teachers in the building. There were cases, however, where teachers felt that their participation in the TLP had no effect on the school whatsoever. It is difficult to determine if this was due to a lack of "presence" on the part of the teacher or because of a school-wide reluctance to embrace technology.

Figure 10



One change is the number of TLP recipients we have in our building. Both _____ and I have shamelessly promoted TLP as an excellent program, and encouraged teachers to apply. Another big change is in the way we distribute computers. Our building received 30 new Dells from the district, meant to upgrade our old Apple IIe lab. Instead, we chose to use those computers to make mini labs in the classroom. All of our classrooms have a six station mini lab, whether it is PC or Mac. Our tech team developed a technology vision this year as well. Many of our ideals have come from our involvement with the TLP project -- our goal is to learn with technology, not about technology.

In the past three years since our first TLP recipient received her technology there has been real growth in our entire school's interest in the use of technology. We have gone from a school where over half of the faculty had no interest or experience with computers, to a faculty that uses technology regularly. Our teachers post their newsletters online, communicate with parents via email, and are in charge of planning the curriculum for their classes when they come to the computer lab weekly. Prior to this we would just drop our students off in the lab and leave the computer teacher to do the job. Lessons are now integrated to our curriculum. Most of our teachers have taken outside technology training during the summers as well. Having four of our teachers lucky enough to have received the TLP Grant has been a boost to our school's interest in technology integration.

The technology and training that I have received has had a huge impact on trainings here in my building. As a result of my leadership, 3 others have now

gotten the grant and have or will continue the momentum. The training model has been copied in how I lead my staff trainings and our district has taken it and used it as well.

I'm not sure that my school has changed too much. Other teachers have followed my lead (I was the first TLP grant recipient in my building) and become TLP participants. Basically, though, the attitude among my fellow teachers is largely that they'll be more interested in incorporating technology into their lessons and classrooms when technology becomes more easily accessible to them (most of our computers are bunched inconveniently together in computer labs).

I am not sure the school has changed as a whole, but we had two new TLP participants in my building this year and will have 4 new ones next year. I am excited by the opportunities that all of our students will have especially in this time with the budget crunch and with the failure of our technology levy. I will be honest that in my department I am a minority with my teaching style so there are many times when I am in my room, trying new things and the other people in the department are not interested. I am hoping next year with some new people and the new curriculum that there will be more collaboration.

Other Findings. While it was generally true that the addition of technology had a positive impact on teaching and the classroom, others remained somewhat skeptical about an integrated program. Some felt that students were becoming too reliant on technology and shunning traditional resources while for others the challenges outweighed the benefits.

The evidence seems to be mixed. While many students take to the technology and choose to use it even when I neither require nor suggest it, others never touch a computer if they don't have to. Tech skills are unevenly distributed. I'm still instructing students to allow word-wrap to work instead of hitting the return key at the end of each line. In that sense technology integration may be interfering with learning. When instruction in using the tools pushes aside the content, it is difficult for teachers, students, and parents to see how the investment is being repaid in increased learning.

Sometimes, the integration makes things easier, while other times, it makes things more challenging. I have found that the key to success lies in making sure that I can explain how the technology improves learning in one or two short sentences. Also, when the integration is seamless, or the lesson cannot stand without the technology, then the projects tend to go better.

I think my view of integrating technology into the curriculum has changed this year. Our building and district have been undergoing budget constraints and reductions. Our file server in our building is going to die soon... only a matter of time, and then there is no money to replace it. Also, I ran into some limits with the memory of the i-Macs that makes me wish I had gone PC! . . . I integrate the

technology, but found out in year one that it doesn't always make things easier or better!

A. The students' paperwork is neater due to word processing capabilities
B. They are learning how to use the Internet more effectively for research-based materials
C. They depend on the Internet too much for their research and are not utilizing other resources that may be more appropriate. The Internet is fast and easy—manuals, interviews, texts, journals, etc...are time consuming to acquire (in the students opinions).
D. Our school has seen a substantial increase in plagiarism on research papers.
E. Our failing rate has increased over the last three years
F. Learners seem more apathetic

Summary

The impact of the Teacher Leadership Project on teaching and learning, on classrooms, and on schools has been dramatic and significant, according to a majority of TLP participants. Students were more motivated to learn when technology was present, and teachers often found them to be more self-directed, more collaborative, more interested, and more on-task. And although there was little evidence other than anecdotal reports to substantiate it, teachers and students were also convinced that learning was increased in technology-rich classrooms. This was due in large part the availability of the Internet, which "puts the world at their fingertips." That the integration of technology has an impact on student achievement has been a consistent theme among TLP teachers over the four years of the program and certainly warrants further study. Teachers reported that their instruction was more substantive and the classroom environment more student-centered when technology was integrated into the curriculum. Furthermore, teachers felt that students were better prepared for the "real world" because of their technical competence.

The following two journal excerpts can be used to summarize teachers' beliefs about how technology is changing the educational environment.

Currently as I write this journal, I have students in a study hall working on various projects. They are attacking different projects using the technology tools in the classroom. Students are selecting the tools that best fit their needs. After two years in the Open Door program, these kids have learned Publisher, Word, and Power Point. Now while working on projects for various classes, they are selecting the tools that fit their needs. Software in this classroom is a choice. Some students select a pencil for a math class and a pen for English. In this class, some students are selecting Power Point and some Publisher or whatever tools are appropriate. The students have not just learned to use the computers they have learned to select the appropriate applications that best fit their needs. That is, in my opinion, an example of higher level learning.

I think some students are learning more because they of their access to technology. Some students do not learn more because they do not care. However, for the students that do care, technology is helpful. When there is a question that we cannot answer, many students know that intelligence is not what you know but knowing where to find the right information. Students' educational experience is better. How can it not be? Information at one's fingertips is exciting. A computer monitor catches and holds the attention of today's students. Technology is part of young peoples lives in everything they do, so making it a part of education seems very natural to them.

Evaluation Question: *What leadership activities have teachers performed during the year?*

The Teacher Leadership Project is intended not only to assist teachers in learning how to integrate technology into the curriculum but also to develop their leadership abilities so that they are confident and motivated to share their knowledge and expertise with colleagues in and beyond the walls of their own school. Summer training sessions and follow-up sessions were designed to focus on this goal, where lead and assistant trainers modeled the role of instructional leader and encouraged new participants to become leaders within their groups.

To determine the extent to which TLP participants actually did share their training, data were gathered from reflective journals, teacher interviews, and the Technology Use Survey. Results indicated that TLP teachers have, as a group, become leaders in the field of technology integration in a number of different ways.

Building leadership. There were numerous ways in which TLP teachers shared their expertise at their schools, according to responses from journals and from survey data. They offered in-services on various elements of the technology integration process including sessions on how to use Word, Power Point and SchoolKit. They also instructed their colleagues in the basics of technology integration such as curriculum design and student management. Teachers facilitated after-school computer classes and clubs as well, where students might produce a school newsletter or simply practice their computer skills. It was not uncommon for teachers to host "Technology Night" events for parents, opening the classroom so that students could share their work and skills with family. A number of teachers took responsibility for making presentations at special school-wide events such as Veteran's Day assemblies or Grandparent's Day celebrations. Many TLP teachers served on school technology committees, helping to develop or implement plans for purchasing and using technology, and some were appointed coordinators of their schools' Gates grant. A number of TLP participants also mentored student teachers in the process of technology integration.

In addition to these responsibilities, teachers spent a considerable amount of time answering technology questions from other teachers. TLP teachers were often seen as "technology experts" and were called on to assist in troubleshooting glitches, installing

programs, using Office software applications, accessing files, and any other number of computer-related issues. Reaction to this role was mixed. Some teachers were happy to provide whatever assistance they could, while others found the demands of being an unofficial technical support person to be overwhelming and intrusive.

The extent to which teachers assumed various leadership responsibilities is presented in Figure 11. However numbers do not capture the enthusiasm and confidence expressed by teachers when they discussed their leadership experiences. The comments of one third year TLP participant sum up the experience and sentiments of many:

> *"Who would have ever thought two years ago that I would be giving a presentation by myself at NCCE? Really! And who would have ever thought I would be teaching a class at the district level? Not me. But just look!"*

This is a powerful statement about the potential of the Teacher Leadership Project to impact education beyond the classroom. The Teacher Leadership Project is proving to be an excellent model of professional development across the state in this regard.

A comparison of first and second year TLP teachers' leadership activities indicated that the more experienced teachers took on a greater number of leadership responsibilities (see Figure 12). For example, while 65% of first year teachers offered building in-services, 79% of second year teachers did so. Similarly, 24% of first year teachers presented at professional conferences compared to 39% of second year teachers.

Figure 11

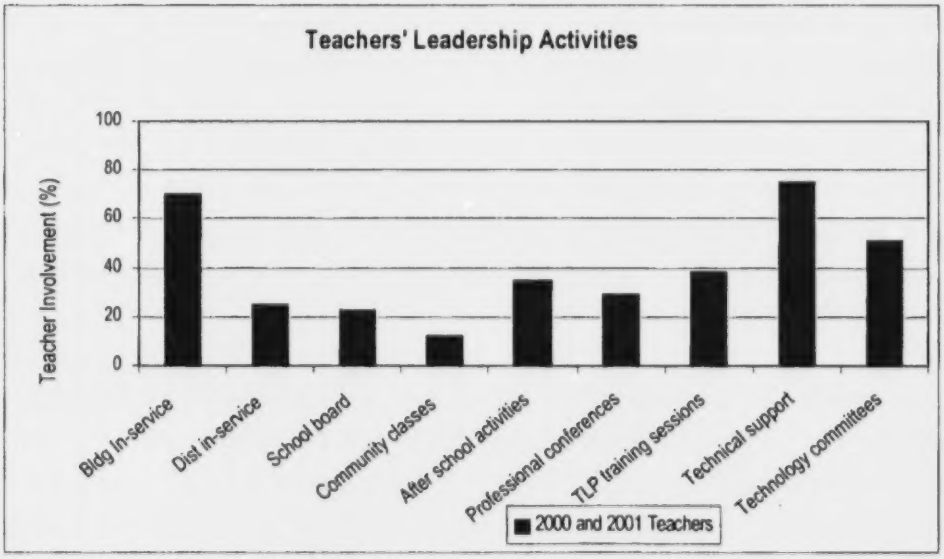
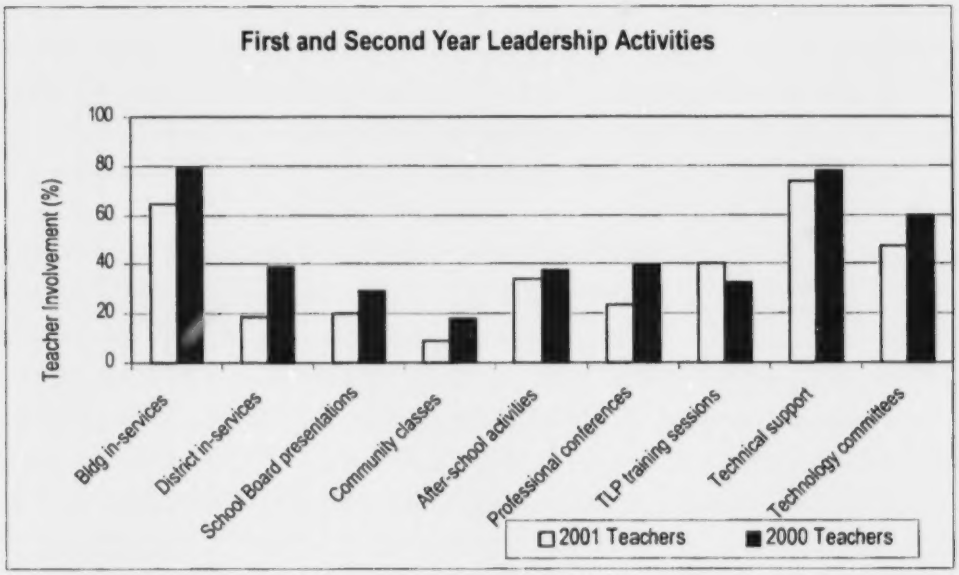


Figure 12



Passages from their reflective journals illustrate the variety of ways in which teachers provided leadership in their buildings during the 2001-2002 school year.

Every Tuesday another TLP teacher and I hold training sessions after school for the rest of the staff. We started off by having set topics, but found that many teachers had specific needs or problems and we found that it was more effective to help them more specifically.

I have continued to provide computer training to our staff, through clock-hour classes sponsored by ESD 112. So far, I have completed 5 classes at 6 hours each, and one class after school in our computer lab. Teachers taking this class have laptop computers and projection devices in their classrooms. They also have at least 5 student computers in their classrooms. Through these classes, our building has become much more focused in our approach to the use of technology and students will be able to see technology integrated at all grade levels.

I am a NUT (Network User Team) Team member for my building. I serve as a troubleshooter, and help with software/hardware decisions.

Another teacher and myself were available after school for 2 1/2 hours to help any elementary teachers in the district who had questions about our new report card, which is on Excel. I field questions continually at all hours and on weekends for teachers who come to me, or call with Grade Machine or Excel questions. (Example-MLK Day helped a Mid-school teacher set up a spread-sheet over the phone while I was at home. We talked on and off over the day 3

times trying to solve his problem. I worked at my computer and he was at his leading him through step-by-step. I go into classrooms and help set up new Grade Machine documents at the beginning of the quarter for people who need that refresher.

Helping other teachers plan an integrated unit using technology.
I have become one of the people that teachers come to when they have technology problems
Create a PowerPoint Slide Show for Jog-A-Thon Assembly, Volunteer Luncheon, and an iMovie of students thanking volunteers for Volunteer Luncheon.

Because of my involvement in this project I have become, by default really, a leader regarding technology in our building. I am always working with teachers from the building who have questions regarding different aspects of technology – from extensive help in using the computerized grading program, to how to produce "things" using the different software applications available to teachers in our building, to teacher web pages, to sharing projects that have worked in my classroom . . .

This year our school received the school wide Gates Grant. I am the evaluator for that program. In the grant, we set up five training days during each of the next three years to learn more about Understanding by Design and integration of technology. I am conduction or arranging for those training days with the assistance of the other TLP teacher in our building. This spring two more teachers received the TLP grant. We were so excited! Our staff has incorporated a tech. Tip into each of our staff meeting and I arrange to share those or often I will encourage others to share.

District and community leadership. Teachers' leadership activities at the district level were similar in many ways to those at the building level. They offered in-services in various computer applications, including Word, Excel, and Power Point. Other leadership responsibilities included serving on district technology committees, working to support legislation for technology funding, and giving presentations to the School Board. Teachers also made connections with their communities through various curriculum projects.

I have been active at the district level both on the integrating of technology and helping with the community bond issue. This year I was the recipient of the Intel Teach to the Future grant where I teach 20 teachers per year. I taught one class in our district last fall and I am planning another one this summer.

I have taught several classes for our district to teachers from all over the district, and I have been designated as the "tech coach" in our building (still not certain what that means). I have been involved in some "grass roots" meetings with the district as they consider starting a "tech cadre" of teachers.

In a wonderful turn of events, I have become a presenter of the new Portal technology to other staff in my district. I will be giving a district in-service in August and will be presenting to other school staffs through out the next school year. This is a turnaround as at one time I was not popular with my district administrator for being a "leader" in selecting and purchasing a different platform from the "accepted" platform for my classroom computers. He now shows my page to school districts across the region.

Students used the computers every day all day, except when we were doing labs or in the field checking on our nest box research project and doing water quality studies for the City of Forks. Following our field research, students use e-mail to send their findings to Dr. Dan Varland, the wildlife biologist in charge of the project, and Rod Fleck, City Attorney and Planner and head of the Mill Creek Study Group. We also post our data from the creek studies on-line (the Washington Virtual Classroom). Students used the Internet and Word to write a research paper about the hypothesis: what is the Washington Virtual Classroom and are our results good for fish? They also used Excel to produce a spreadsheet with the results, inserted text boxes and incorporated pictures from the field work into their documents so that they could send this information to the Mill Creek Study Group (which includes landowners along the creek.) All had to produce a visual display for a conference where I made a presentation (Washington Association of Science Teachers) about our science research. We also did a video conference with Senator Patty Murray (she in DC us in Forks) about our water quality studies. All of the groups of students worked on a web site using Word and digital pictures that we took. This was their quarter project and all were simply wonderful! We did two on-line web quests (through Access Excellence) that were very fun for the students and challenged them to think.

Students participated in a Veteran Connection project. In groups of three, students audio-taped and interviewed veterans in our community. They then transcribed their tapes into word processed documents from which they prepared a story-telling for their classmates and a school-wide veterans day assembly. We will continue to work on and edit the word-processed stories and prepare them for publication. My ESD will pay to have these stories bound into a book.

Professional leadership. TLP teachers also took an active role in professional conferences and TLP training sessions. Teachers reported presenting at both the NCCE and OSPI conferences in Washington state, while others either attended or made presentations at education conferences and technical meetings across the country. An impressive 29% of the teachers who responded to the survey reported that they had taken part in at least one professional conference, while 38% had served as lead or assistant instructors for Teacher Leadership Project training sessions. In addition, a number of teachers participated in screening applications for future TLP cohorts.

I was a presenter at the Washington State Convention Center, in Seattle, for the Northwest Computer Conference for Educations in March 2002. I completed my master's in education & technology.

In terms of leadership, I am chairing a strand at the National Science Teachers Association Regional Conference in Portland in November, and read proposals for that strand. I continue to be an active WSTA member, and former board member, working on reform in science education, including the piloting of the science WASL, and on selection teams for materials for a current NSF grant involving several school districts in our area. My interest is in finding curriculum materials that include technology as part of the design, not an add-on provided by the teacher.

I have been involved in helping to teach all three of the TLP regional meetings for the 3-5-grade band here in Spokane. I also read grant applications for the last two years.

I provide after school workshops for teachers in my building to help them learn PowerPoint so they can teach their students how to present their projects using technology. I am involved as a regional rep for the Washington Science Teachers Association and chaired the WSTA Science and Engineering Contest as well as wrote a journal article and presented at their state science conference. I am on the OSPI SALT team, writing science WASL items for the 5th grade test. Additionally, I recently received the Presidential Award for Excellence in Mathematics and Science Teaching in Washington, D.C. this past March. A couple of weeks ago I received the Washington Initiative for National Board Teacher Certification scholarship to pursue NBPTS certification during the 2002-03 school year. I also chaired our . . . Science Extravaganza all-school event, our . . . Egg Drop competition, and the Science Olympiad.

Finally there were those teachers who remarked that they had worked "behind the scenes" as quiet spokespersons regarding the TLP and technology integration.

I have provided some leadership in the use of technology related to Accelerated Reader this year, and I am currently taking part in "Tech Sharing" meetings. I have also passed on useful information and websites gleaned from the TLP listserve. I have continued to try to use the technology training I received from the TLP to help fellow teachers who are having trouble with technology in their programs. I haven't done anything "spectacular" but the things I have done would not have been possible without my TLP background.

Student leadership and sharing. Teachers were not alone in sharing their technology skills and knowledge; students assumed leadership responsibilities as well. Teachers reported that their students provided ongoing assistance to each other, to students in other classrooms, and even to other teachers and administrators in the

building. Some classes became "buddies" to younger students, teaching them how to use programs or assisting them with curriculum projects. Teachers shared the following examples of student leadership.

> *My class helped our principal make a PowerPoint presentation to show to the whole school about a climbing wall that our PTG has purchased. They thought that was really neat. My class has been partnering with a second grade class and taught them how to make graphs in Excel, and do research with Encarta and put it into a report. This is the most fun of all to see them teach their skills to other students. They are beaming from ear to ear. I am continuing to do leadership activities in my building and am often the contact person when someone has a computer problem.*

> *My students have taken on leadership roles within themselves. They help each other. I even have teachers that have some of my students show them how to use different computer and software functions. This is a big self-esteem builder for many of them. I have been encouraging classroom teachers to do more with the technology in the classroom. I will be working with our computer lab person next year at how to use technology as a tool for learning rather than a place to play games that reinforce more of the drill and kill syndrome.*

Summary

Teachers were grateful for the leadership opportunities made possible through their participation in the TLP, and a number took advantage of those opportunities to share their knowledge and expertise. They served on technology committees, taught classes, presented at conferences, led and assisted at TLP training sessions, participated in grant applications, and provided technical support. In addition, some TLP teachers developed projects that connected student learning and the community. Students also took on leadership responsibilities in the classroom and in the school.

Evaluation Question: *What is the appropriate use of the technology for K-2 students?*

While there is a general assumption that technology has a place in all classrooms, questions remain about the implications of placing computer technology in K-2 classrooms. During the 2000-2001 school year 125 primary teachers were selected to participate in the TLP. An in-depth evaluation of those classrooms found important benefits to placing technology in the hands of young children. These included:

- Technical benefits. Primary children developed the ability to manipulate and navigate a number of computer programs and tools.
- Academic benefits. Although difficult to quantify, there was evidence to suggest that student writing was improved, as was their ability to access and use

information. In addition, it appeared that the quality and quantity of student work was changed for the better because they had access to technology.

- Student attitude. Computers proved motivating to primary students and appeared to lead to more on-task, academic behaviors.

On the other hand, the same evaluation identified concerns and challenges to placing computers and related technology in K-2 classrooms. While some of challenges were similar to those faced by intermediate and secondary teachers, others were unique to younger children. For example, primary teachers had to consider their students' developmental limitations when planning technology-integrated lessons. The fact that young children were in the early stages of writing and letter and number recognition limited what they were able to accomplish with the computers. As well, their lack of fine motor skills made keyboarding and mouse control more difficult. Management of primary students was challenging as well. While young children were surprisingly competent in learning technical skills, they were not completely independent, and several teachers questioned how computers could be used effectively in primary classrooms without additional help. The study also identified a need for more developmentally appropriate software and for a training program focused exclusively on the requirements of primary teachers and young children.

For these reasons, the 2000-2001 evaluation included several recommendations regarding the K-2 component of the Teacher Leadership Project. These included, among others, recommendations to modify the hardware and software requirements and the training sessions. Based on these recommendations and on feedback from primary teachers, the K-2 component of the TLP was in fact restructured in several important ways. First, since a number questions remained about "best practice" at the primary level, the number of K-2 teachers selected to participate during the 2001-2002 school year was decreased significantly (from 125 to 25). The following statement, released by ESD189, provided a rationale for their decision to limit the number of K-2 participants.

> When the Gates Foundation and the ESD decided to expand the TLP last year [1999-2000], it was done with relatively little information about how integration would look, or could look in the primary grades. This was due, in part, to the short selection timeline, but also to the lack of research in this area. It has become clear from feedback received at the summer training sessions, regional meetings, journals, and interviews, that in fact integration does not necessarily look the same in the primary grades as it does in higher grades, where all our efforts have been focused previously. The decision to cut back the number of grants to primary classrooms was made so that this area of technology integration could be studied further, and in depth, to determine what the best use of resources is in grades K-2. Gathering more information will allow the ESD and the Foundation to proceed thoughtfully and purposefully in providing technology resources in the future. This decision in no way reflects a lack of confidence in what primary teachers have done this year. Rather, it is an attempt on the part of the ESD to determine more fully the potential and most appropriate uses of technology in K-2 classrooms (ESD189, March 2001).

In addition to the decrease in K-2 participants, changes to the K-2 program included:

- Hardware modifications. K-2 classrooms were to be equipped with a minimum 1000 lumen portable projector, visual /desktop presenter (could include a combination of document camera and projector or all-in-one solution), three classroom computers and one printer.
- Training. K-2 teachers were placed in one group for training purposes, and instruction and materials were focused at the primary level.

Taking these modifications into account, the 2001-2002 TLP evaluation again studied the ways in which primary teachers and students used technology so that the benefits, challenges, and the influences on student learning could be further understood. Data were gathered from several different sources including teacher reflective journals, the Technology Use Survey for Teachers, classroom observations, and teacher interviews. A summary of data responses is shown in Table 4. Results are presented and discussed relative to the following questions:

1. How is technology used in primary classrooms?
2. What are the benefits of technology integration in a primary classroom?
3. What are the challenges to using technology with young children?

Table 4: Sources of Data for K-2 Teachers

	2001 Cohort	2000 Cohort
Reflective Journals	101	100
Teacher Interviews	5	4
Classroom Observations	5	4
Survey Responses	22	38

Computer Use in Primary Classrooms

An analysis of K-2 teacher journals, interview responses, and observation data revealed consistencies in the ways in which primary teachers utilized technology. Students frequently used the computers for word processing. Teachers reported that Word, KidPix, and Kidspiration were their programs of choice, and they found teacher-developed Word templates useful in guiding student writing. Excel was used to a lesser extent than word processing software, and more often by second grade teachers. Power Point was popular as well, although younger children's efforts were less extensive than older students. For example, kindergarten and first grade students might work with "helpers" (parents, aides, or older students) to design one slide for a presentation. Both teachers and students used Encarta and the Internet to gather information, and teacher responses indicated that they often pre-identified and bookmarked sites for students. To some degree skill development programs such as Reader Rabbit and Math Blasters were

used, and they found that Accelerated Reader greatly increased student's motivation to read. Primary teachers seldom used SchoolKit lessons.

Survey results generally supported journal and interview data. For example, as shown in Figure 13 a majority of primary teachers reported either extensive or moderate use of word processing and presentation software as well as research applications (Internet, Encarta). Findings from the survey indicated that about half of the teachers (48% of all K-2 respondents) used skill development software while 51% used the computers for data analysis.

Typical activities and lessons using technology are described below for each grade level, followed by illustrative journal excerpts.

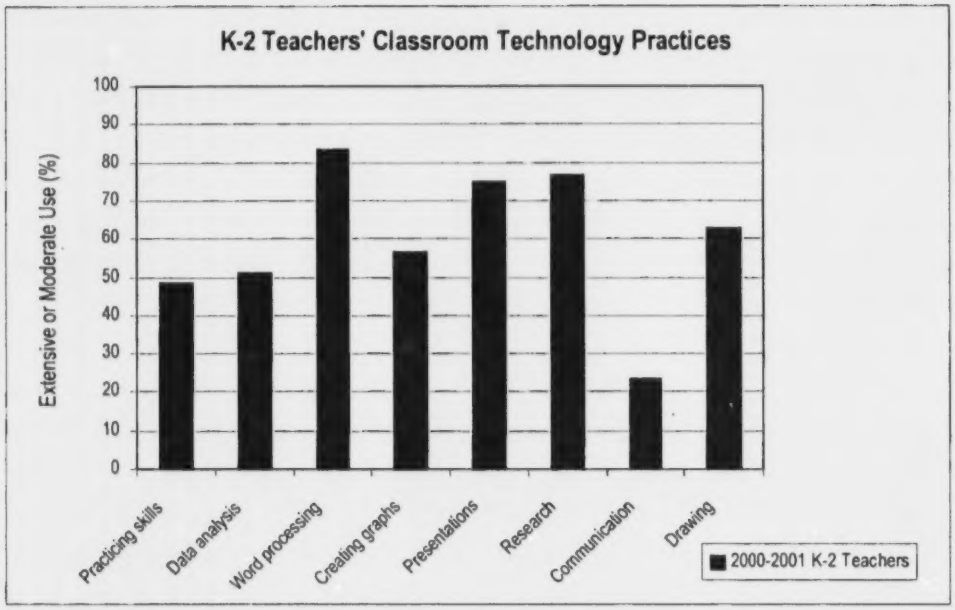
Kindergarten. Practicing name writing, recognizing and matching upper and lower case letters, directed journal writing, working with buddies on Power Point slides, and practicing skills.

> *The Ks picked out an animal and then learned how to import a clip art picture of that animal. They found out a number of facts about animals from both books, Encarta and several web sites. We are currently in the process of completing a Power Point presentation with our buddies on these animals. The 6th graders are of course doing much of the power point presentation but I hope that the Ks will be picking up a few basic skills that may help them making presentations in the future.*

> *For the last two months the kids have been making a slide show in KidPix. One of our big kindergarten units is "Trees," using the FOSS science curriculum. One of the suggested activities is to have the children draw a picture of a tree in each of the four seasons . . . I had them also write a sentence describing the tree and they used the textbox icon to type it into the slide. The children are now adept at using KidPix and also have a solid understanding of how trees change with the seasons.*

> *At the beginning of the school year, I installed Bailey's Book House and Millie's Math House on the computers . . . These programs help the children learn how to use the mouse. Next, I had the students use the paint program, as I wanted to be able to do an illustration for a project. I showed them how to use the pull-down menus to get a clean canvas . . . They were using the text feature to write random letters, so I introduced the Word. I showed them how to change the text, space bar, enter, and arrow keys. They like to write their names and the words we have in the classroom.*

Figure 13



1st Grade. Completing Word templates, creative writing, preparing Power Point slides, reading (Accelerated Reader or "Read-along software), skill development and simple graphing.

> *I am continuing to have my first grade students create poweroint presentations about themselves and their families. This year I am hoping to get recordings of family members to tell about our students. This recording will be used on their powerpoint . . . We are moving into our study about a country for Social Studies and this year we have chosen Africa. Student will choose the topic of interest for themselves and participate in projects. These projects will include PowerPoint presentations, Publisher - Brochures, Excel graphs. etc. Topics will include: general overview, animals, rainforest, stories, Black Americans, culture, etc. We will present to the whole school in May.*
>
> *The latest projects I've got going include (1) a digital video powerpoint presentation we are creating of the kids reading out loud in their best expressive voices, with each student reading 1-2 pages of one of the class stories (an idea I got from one of my fellow tlp teachers). The final product will be shared with the school community, using our projector and the laptop, during the spring variety/talent show; (2) the class digital scrapbook, encouraging students to write their memoirs of the year through adding captions to a webpage full of their pictures from the school year, and (3) each student is using a powerpoint*

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template to publish their final draft of an animal information book, documenting the animal research they are doing using Encarta as well as traditional sources.

In my first grade class, we are studying pioneer lifestyles and Laura Ingalls Wilder. As part of the unit, we've used Encarta to research as a whole group. (In first grade, using Encarta independently is only an option for my high readers.) We used WORD to create a classroom big book comparing pioneer life to life now. I'd like to create a Power Point presentation with my students based on this book that we could share with our fourth grade buddies. Additionally, I've integrated technology in small ways in math and science. We used the digital camera to create a bulletin board challenging people to determine which pictures of pattern blocks were symmetrical and which were not.

2nd Grade. Writing, completing templates, creating Power Point presentations, information access (author sites, animal sites), and recording science and math data.

My most recent integration of technology into the curriculum was when my students worked in pairs to create a Power Point presentation of "Ways to Save the Earth". This went along with our study of ecology and the earth. We used our Scholastic News periodical for ideas, as well as various websites. As a class we brainstormed a list of things we could do to help save the Earth. We also incorporated a story from our reading series called, "The World's Plants are in Danger". Each pair of students worked together choosing the ideas they wanted to develop from our list. Using power point, they typed their ideas onto each slide. They added graphics from the clip art files to illustrate their ideas. They learned how to import graphics, including motion clips. They had a great time making their choices! Students added their recorded voices to narrate each slide in the show as well as some sound clips from the sound clips file.

Some of the ways we are using technology are:
**Create pictures to go with stories using PAINT*
**Take AR tests*
**Use OPAC library search to look up authors and subjects of interest that might be in our school library*
**Use Academy of Reading software*
**Use WORD to write complete sentences, practice nouns and verb identification using highlighter, letters etc.*
**Exploration of websites and searching techniques*
**Using websites for instructional support of math concepts, research information*
**WebQuesting*
**E-mail*
**Use Power Point with digital camera for portfolio development*

While teachers found a number of ways to put technology into the hands of students, perhaps the most compelling finding there was the degree to which teachers used the technology for instructional purposes. Their enthusiasm for "Elmo" cannot be

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overstated. Even though they received fewer student computers than the previous cohort of primary teachers, they were unanimous in stating that they would "*never*" want to give up their document cameras and projectors for more computers. In fact some teachers indicated that they used the technology more as a teacher resource and tool than they did as a student tool. Teachers frequently used Elmo for demonstrating handwriting lessons, art projects, and sharing Internet sites and information, while students were able to share and explain their writing (journals), math problems, and pictures. Students could see better and were more motivated to pay attention when lessons were projected onto the big screen. The following examples give a sense of how powerful teachers found the presentation hardware.

> *As before I am finding that I am using the technology in my classroom for instruction more than they are actually using it... (For example) when I introduce a new letter of the week I take them to a web site children's dictionary where they look at all of the things that start with that letter. I first show it to them using my laptop and projector and then they use the classroom computers to explore on their own. The final task is for them to draw and label if they can pictures which start with that letter in their ABC books. They write their names, practice writing numbers and draw pictures and write using Kid Pix. They then can print these pages. I am going to use some of the number writing pages as part of an assessment for our progress reports.*
>
> *I have been able to model activities with the three-dimensional cubes using the Elmo, that I never could before with an overhead projector... Excitement level was high during our science lessons on insects. Students were able to easily observe as larvae metamorphosized into pupa, caterpillars formed chrysalises, and butterflies emerged from cocoons. The teacher was happy because this eliminated children crowding around the insect containers and jostling for position amid cries of "I can't see! I can't see!"*
>
> *Often, due to the developmental level of my students, many activities are teacher used and directed. I have created a variety of PowerPoint presentations that aid in student learning. I have also begun using hidden text and forms (in word) for student projects.*
>
> *There has also been increased attention from my students when I use the Elmo/projector. In the past, if I had to show the kids what to do by holding up a piece of paper or book and pointing to it, I lost the attention of the kids who could not see it well. Now I can show things to the entire class on the screen using the Elmo/projector.*
>
> *(I am) using the projector and Elmo for brainstorming, writing letters, showing art examples and pictures for drawing, great for demonstrations of folding paper, etc... I love the projector and the Elmo!*

The students are getting more out of our Science Workshop time because they are all able to see the experiments on Elmo. Not only does it keep them engaged, but seeing it up close has helped them ask amazing questions about how the person conducted the experiment.

I have had my equipment since October. I still believe my most useful tool is the Elmo presentation device. We use Elmo for everything. I model journal writing and then the kids share. I give directions for assignments and model how to play games. The kids have become more independent using the computers. They have been challenging themselves to take more Accelerated Reader tests. We also listen to books on tape. I haven't implemented any projects at this point. I have also been using the projector to model how to use forms. I have created a form letter for the different word families. The kids will go to the computers during reading groups and print their answers.

Generally, then, primary teachers utilized their technology frequently, both for instruction and for student activities. Typical student use included writing (Word, Kid Pix, Kidspiration, templates), and skill development (Reader Rabbit, Math Blasters and the like). Teachers also used projection devices on a regular basis to share Internet sites, Power Point lessons, and to present student work.

Benefits of Technology Integration for Primary Students

Teachers were asked to discuss in their journals and in interviews ways in which they believed students benefited from being in technology-rich classrooms. This is a critical question because, as Healy noted, "If the computer can accomplish the task better than other materials or experiences, we will use it. If it doesn't clearly do the job better, we will save the money and use methods that have already proven their worth. In the case of the child under seven, there are few things that can be done better on a computer and many that fail miserably by comparison..... [they] are better off spending this valuable time in a physically and linguistically enriched environment" (1998, p.218). Responses from first and second year participants were consistent, and several key ideas emerged.

A learning tool. First, teachers suggested that computers are "another educational tool" for helping students learn. As one teacher commented, "Technology is like one more intelligence, and for some kids it can be a motivating factor in their success." For example, when young children are learning to write their name they practice with crayon, pencil and paper, play-doh, or paints. The computer offers them one additional means of practice. Primary-age children also spend a good deal of time learning math facts. This is done with flash cards, worksheets, math manipulatives, and other game-type activities. Computer programs such as Math Blasters give students a chance to learn their facts in another format, and K-2 teachers agree that this is an important factor in the learning process.

Motivation. Another benefit of integrating technology into the curriculum was the way in which it motivated students to participate in learning activities. All students are generally enthusiastic about using computers, and primary students were no exception.

They enjoyed practicing skills, sharing their work, and even watching "direct instruction" lessons when they were presented with technology. Several teachers connected the motivation to student learning, suggesting that engagement led to exposure and exposure led to learning.

> *Motivation continues to be the number one benefit to using technology in the classroom. Students view the use of technology as "more fun" which makes it easier to teach. Students are eager to work with the computers and thus are willing to work harder and to produce a better quality work than I have seen with typical paper/pencil tasks. Generally there is an increase in the volume of work produced also.*

> *They eagerly approach writing and research projects if they know that the computer will be available to them in their work. They spend more time collecting and gathering information than if they only had a book to look at. They work harder to organize their information and make careful choices about using pictures in their reports.*

Writing. Nearly every primary teacher discussed the advantages of having computers available for writing activities, and many suggested that their writing was indeed greatly improved when students used the word processor. This is interesting since a number of teachers also reported that students' general lack of keyboarding skills limited what they could accomplish on the computer. Writing with pencil and paper can be a laborious task for young children with limited fine motor skills, and in many cases the computer offered these youngsters an easier and more motivating way to record their thoughts, regardless of their keyboarding skills. Besides writing more, teachers reported that students paid more attention to writing conventions when their work was done on a word processor. For example, they noticed punctuation, upper and lower case letters, spacing, and the like. When they knew their writing would be projected in front of an audience they paid particular attention to the details. And so while the lack of keyboarding skills limited their writing to a certain extent, it was often no more of a handicap than the tedious process of composing with pencil and paper, and in fact the motivation factor inspired students to spend more time and pay more attention to the fine points of writing.

> *My students are better writers now than the class I had two years ago. I believe that because we can dig further into the writing process by using the technology, my students benefit. They write complete stories with beginning, middle, and end, and they better understand sentence phrasing and correct spelling. Getting to publish on the computer motivates my students to write, and the more practice writing that they get, the better they become. The other significant benefit to this writing program is the positive effects it has on the beginning readers in my class. Reading improves when students write and read their own words. They begin to make connections between reading and writing, and in turn their reading achievement is impacted in a positive way.*

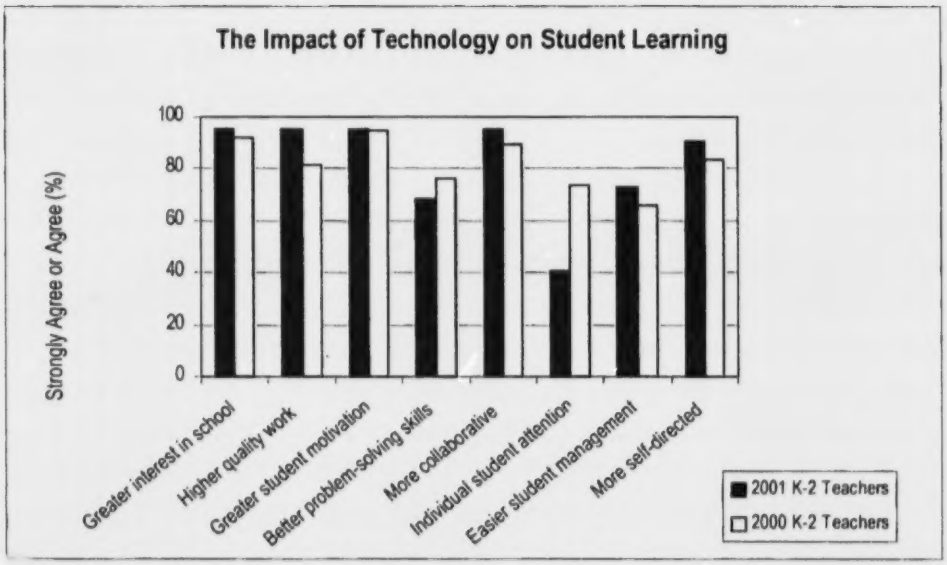
The students use the computers for spelling practice and writing sentences. They are more efficient with their time on the computer than with paper and pencil activities. They are more alert to punctuation and details than with paper and pencil activities. Students have an incredible amount of pride with finished work from the computer.

Problem-solving. Teacher responses also suggest that students' problem-solving abilities were improved as they spent more time using computers. Specifically they were more inclined to think creatively, they were more patient and persistent in solving problems, and they were more apt to stick with a task. These behaviors may have been due in part to the collaborative nature of computers. But more than that, there was something inherently engaging about the computer that inspired students to "stick with it." As one first grade teacher noted, "The students are less intimidated by frustrating tasks when they are allowed to use technology as a tool." And a kindergarten teacher found that "children are better able to deal with problems with less frustration. They also are more willing to try new things."

Survey responses generally supported information provided by teachers in their journals and in interviews. For example, K-2 teachers overall found students to be more motivated (95%), more interested in school (93%), more often on-task (92%), more self-directed (87%), and found that their work was of higher quality (87%) when computers were integrated into the classroom (Figure 14). These findings were consistent with journals responses. However survey results regarding student management were interesting and conflicted with qualitative data. Journals and interview responses suggested that managing young students and computers was challenging, while survey results indicated that a majority of teachers found student management to be easier when technology was integrated into the curriculum. In the case of the survey, management may imply discipline rather than supervision, in which case their positive responses are more reflective of journal data.

Another area of interest was the difference in first and second year teachers' perceptions of how the presence of computers affected their ability to provide individual help to students. Less than half of first year TLP participants (41%) felt that computers allowed them to they provide more individual student help, while nearly 75% of second year teachers found this to be the case.

Figure 14



Additional benefits. Although they were not stated as often or as strongly as previously mentioned benefits, teachers did identify other ways in which computers had a positive impact on their students.

- Students who did not excel in traditional school activities such as reading, writing, and math often found their niche in a TLP classroom. In some cases their peers saw these children in a whole new light because of their computer expertise.

- Some teachers saw a transfer of "technology" behaviors and skills to other situations in the classroom. For example, a child's tendency to collaborate and problem-solve carried over to other learning and social situations.

- Technology leveled the playing field, according to many teachers, and less able students were able to produce work similar in quality to their classmates.

- A few teachers cited emerging evidence of improved academic achievement. This was due mostly to student use of Accelerated Reader, although gains in writing were also noted. While there is little data to support these suggestions the references to improved student learning were so frequent that it did become a pattern.

- Instruction could be individualized using computer technology. Accelerated Reader and Accelerated Math both allowed students to progress according to their

academic performance. In addition, computers offered enrichment or remedial opportunities for students with special needs.

Journal and interview excerpts illustrate these and other findings.

My students' increased learning is evidenced in many ways. First, with the use of Accelerated Reader and Accelerated Math, all students are able to practice their skills at their own levels. Students "look the same" when they are working and no student feels badly that they can not do the work, or that they are doing something easier than the rest of the class.

We recently completed a Levels Test for second grade students at our school. My students scored very well! I have four special education students as well as five more students who qualified for special help in reading. I was very pleased with their test results. Of course, I cannot say that this was only because of the technology assisted learning they have been exposed to, but perhaps it was in part of the reason.

My students are also better at public speaking due to the addition of technology to our classroom. We used Power Point to produce informational slide shows. This year, we used it to educate our fourth grade buddies and our parents about penguins. The students learned to speak clearly in front of an audience while using the slide as a reference tool.

My principal informed me recently that our grade level has a higher level of students exiting the Title I (reading support) program than any other grade. This is due, of course to many factors, but I have been concentrating much of my computer use to the Language Arts, and this may be a contributing factor.

Challenges and Concerns in K-2 Technology Integration

While teachers identified a number of benefits to using technology with young children, they also pointed out challenges and concerns. Findings were similar to those reported by K-2 teachers during the 2000-2001 school year, and include the difficulty of using computers with students who were just developing literacy skills, who had less developed fine motor skills, and whose level of independence was limited. More important, perhaps, were concerns raised by teachers about the necessity and appropriateness of creating technology-rich classrooms for young children. During the first year of the K-2 implementation, there was a general assumption among primary teachers that young children *should* be exposed to technology much like their older peers, including at most a 4:1 student to computer ratio. These assumptions were challenged over the course of the 2001-2002 year, causing several to modify their thinking about the K-2 integration model. The following discussion addresses both the challenges and concerns raised by teachers.

Challenges. A number of the challenges reported by K-2 teachers were no different than those reported by intermediate and secondary teachers and included time

for planning, technical glitches, lack of technical support, and server malfunctions. However primary teachers also encountered challenges unique to their situations that were related mostly to the developmental level of their students. These were, in fact, the same challenges identified by the 2000-2001 cohort of K-2 teachers. First, primary students who were just learning to read could not utilize the computers in the same ways as their older peers. For example, much of the integration that takes place in intermediate and secondary classrooms centered on searching for and reading information from the Internet. This required reading and comprehension skills that were generally beyond those of most of kindergarten, first, and second grade students. This being the case, one of the most effective means of utilizing computers in upper grades was of only limited use in primary classrooms.

Another challenge to using technology with young children, according to primary teachers, was the degree to which they were still developing fine motor skills. While their abilities were certainly impressive, some nevertheless struggled with keyboarding and controlling the mouse. Because of this, computer activities tended to take a long time, and teachers had to decide whether the outcomes were justified by the time. In some cases they were, in others they were not.

Finally, the new group of TLP teachers again found that young children often had not reached a level of independence where they can complete computer projects without assistance and direction. Their ability to follow multi-step directions and to "get out of trouble" when something goes wrong limits the nature and complexity of tasks they can accomplish. Teachers have found that computer time is often more successful when parent helpers, classroom aides, or intermediate "buddies" are available to work alongside their students.

> *Student management is my main factor right now. I have a class that still needs constant guidance on what to do . . . I am still leery of letting them go.*
>
> *Some of the things we have struggled with are: the students' lack of fine motor skills, inability to read the screen and an overall lack of group skills. Last year my students were much farther along in all of these areas and it was easier to jump right in to integrated activities.*
>
> *In order to be the most efficient and effective teacher I can be, I have to constantly weigh the value of the projects we do. Sadly, sometimes it is just faster to use pencil and paper! However, as their skills improve, I hope to integrate computers more . . .*
>
> *Student management has gotten better now that my kids are getting older. I have supportive parent volunteers and some students who are able to help when there is an issue.*

Other issues that emerged as significant challenges during the first year of K-2 implementation proved less problematic during the second year. For example the lack of

appropriate primary software was a particular concern during the first year of implementation, as was the need for more developmentally appropriate lessons. Room arrangement and student management were also topics of concern during the first year. It seems clear that while modifications to the K-2 training model did not eliminate these concerns, they *did* ease them. The summer training session and follow-up meetings during the year were taught by experienced K-2 TLP teachers who focused their instruction on the academic and social needs of primary students. With more developmentally appropriate lessons and resources available, first-year challenges became more manageable.

Concerns. While teachers were overwhelmingly positive and consistent in reporting the benefits and challenges of integrating technology into the K-2 classroom, some struggled with the question of "appropriate use." Of particular interest were the responses from teachers who had moved from a higher grade (2nd or 3rd) to a lower grade (K or 1st). They reflected on the assumption that computers should *necessarily* be placed in primary classrooms and commented on the challenges of using and balancing technology with the more important "traditional" literacy activities. One teacher who had integrated technology at both first and second grades commented on this dilemma.

> *If you aren't in a looping situation where you will be with your students two years in a row, you might be better to wait and integrate the technology at 2nd grade. The same thing could be accomplished if you started later . . . but still, there is the motivation to consider, and the benefits of cooperative learning . . . .*

Others shared their thoughts regarding technology and young children.

> *When I first learned last spring that there would be fewer K-2 teachers involved in the 2001-02 TLP project, I was upset. I didn't think that there had been enough time for the program to be in place in K-2 classrooms to be able to cut back at those grade levels. After my second year, though, I can see that that decision was the most appropriate. There just isn't enough time in the day in a Primary classroom to do the best job of integrating the technology into the curriculum. There are so many things to accomplish in the classroom, even beyond the basic curriculum, and it gets to the point where you have to decide what you have time to do and what goes. The younger children require so much help when learning applications. For most, this is a new experience for them, and it takes a lot of guidance to help them get to the point where they are comfortable working independently or with a partner.*

> *My views are that technology is an essential component of a curriculum if you want children to think at application, synthesis, and evaluation levels. I used to firmly believe it belongs in all grade levels equally. This year I have discovered that it is very different in first grade – much more so than second. First grade requires more teacher demonstration, more teacher control and more scaffolding than second.*

I have an interesting situation with looping back to first grade. I have been a little hesitant to rush right in and get the computers up and running. Several reasons for my waiting are that 1. I don't have the parent help I have had in the past. Right now I have two parents that can only come on Fridays. Second, with all that they keep pushing at us curriculum wise I am finding it a lot harder to find time in my day to establish my 'computer' integration. I have been giving it a lot of thought over my vacation time and have some ideas. But, my goal is to get the computers up and running now that most of my class knows what the letters look like. I am taking it slow and easy. I don't want to rush and not do a thorough job of teaching the basics. I have introduced the paint program and some interactive computer programs that integrate with what I have been doing in class.

I am not integrating technology nearly as much as I would like to be this year. I switched grade levels from 2nd grade back to 1st grade and the emphasis in my classroom has been primarily on district reading and math curriculum due to the low academic level of my class. I have a majority of the lowest 1st graders in the school in my classroom and, therefore, I feel a strong duty to focus on their literacy acquisition especially early in the year. I am hoping that I will be able to integrate the technology more as the year progresses and their skills increase.

I think it's impossible to definitively say right now that my students are learning differently because of the technology. I think I will have a much better idea when I see what they can do for me next year, after two years with the technology, and having started in first grade. We also take the ITBS test in second grade, and I'm curious to see if the results will be different than those of my students in years when they didn't have the advantages of integrated technology.

Essential components of a sound program. All TLP teachers were asked to comment on the components that they believed were critical to a program such as the Teacher Leadership Project. Primary teachers agreed with their 3-12 colleagues that without in-depth training, the likelihood of using technology effectively was limited. In addition to training, however, the analysis of K-2 journal responses and interview data provided insight into the necessary elements of a sound primary technology program. Teachers agreed on these elements with few exceptions. First, without question, was "Elmo" or a similar document camera and projector set-up. New TLP teachers were unanimous in identifying this as an indispensable piece of equipment, and although second year teachers did not receive a document camera as part of their grant, those who were familiar with this technology felt it should be a requirement for all K-2 participants. Almost as important as the document camera, said primary teachers, were the laptop computer and digital camera. Digital pictures were often used in student newspapers, brochures, class books, and for recording field trips. Teachers considered this technology an important learning enrichment tool. Finally, K-2 teachers agreed on the software that they consider necessary for a sound primary program, which included Office, Encarta, Kidspiration, KidPix, Accelerated Reader and selected skill development software.

There was also consistency among K-2 teachers on what they considered "useful but optional" equipment. Most often mentioned were the scanner, video camera, CD burner,

color printer, zip drive, and DVD drive. While teachers who had this hardware appreciated it, in no way was it as important as the document cameras, laptops, and digital cameras.

> *For the K-2 grade band, I would say the projector and document camera are tops on the list of necessary hardware. You can do with fewer computers (although I LOVE having 8 student stations because little children often have a hard time with sharing—the smaller the groups, the better!) but being able to show things whole group is imperative. I only have a TV View Silver and the kids can't see it well enough to make it useful.*

> *What is going really well is how smooth the transitions are becoming for both the children and myself, in terms of when and how to use the computers. I also think that the ELMO is the most useful piece of equipment. I am now very comfortable with it and how to switch from using the computer on the big screen to using the ELMO to demonstrate different things under it.*

> *The low student to computer ratio, projection device and document camera, and a digital camera are what I would consider the bare minimum needed to do incredible things. My scanner and digital video camera are just icing on the cake! They're great, but they almost take more time than it's worth to get effective use out of them.*

Training. Given teachers' responses to the revised training program, it appears that efforts made by ESD189 to modify the K-2 curriculum were successful. The instruction and content were focused on the needs of primary teachers, and changes to the hardware requirements proved advantageous. Teachers also appreciated the hands-on lessons, the time to collaborate with their K-2 peers in developing curriculum plans, and the networking opportunities. Instruction in specific applications such as Excel, SchoolKit, WebQuests, and Power Point was valuable as well.

> *Every aspect of my training has been helpful. One of the best parts of our training is the intensive, hands-on learning that we have done. This process requires me to learn, practice and use what we've learned so that I can clearly recall it when I need it to teach. I also have greatly benefited from the experimenting we have done. I finally feel that I can do things and take chances without the whole computer crashing.*

> *The training we are receiving is indispensable. Despite my interest in technology and desire to use it in the classroom, had I been handed all of these wonderful tools without the training, I know that I would be struggling to find effective ways to integrate everything with my existing curriculum. The training is practical and instills one with the confidence and tools to use technology to the advantage of both student and teacher.*

Recommendations

While K-2 teachers were consistent in identifying the benefits of adding technology to their classrooms, some continued to ponder the most appropriate use of technology for young children. Certainly there was no denying the motivational impact of having computers available, and there was a general consensus about the potential for improving student reading and writing. Rather, questions centered on the timing of placing computers in the primary classroom. Teachers of all grades find themselves with "too much to teach, and not enough time to teach it." This is particularly true for primary teachers who are charged with developing fundamental and essential literacy skills. At this early stage of integrating technology into the curriculum, some primary teachers are not convinced that earlier is necessarily better, given the time constraints they face and the developmental level of their students. It is a question that needs further study and is among the following recommendations made in light of the K-2 evaluation:

- Continue to provide a training program and curriculum focused specifically on the needs of K-2 teachers and their students.
- Continue to require a document camera and projector as a condition of the grant to K-2 teachers.
- Conduct a thorough and ongoing search of available software products to identify and share programs that would be useful to K-2 teachers.
- Continue the evaluation of K-2 classrooms to better understand the most appropriate use of technology in primary classrooms.

Summary

Primary teachers continued to find many uses for technology in their K-2 classrooms. Students learned technical skills, such as opening and closing programs, saving work, completing templates, designing Power Point slides, using various word processing features, and practicing their skills. Teachers also believed there was at least limited evidence to suggest that technology had an impact on student learning, most often in their reading and writing abilities. Attitudes and behaviors were affected as well, with most teachers reporting that their students were more motivated, more collaborative, and more persistent in the face of problems and frustrations. On the other hand, primary teachers faced a number of challenges. Younger students were not able to use technology in the same ways as older students. Their emerging reading skills limited their ability to use the Internet, and keyboarding and mouse control were challenging for some. In addition, younger students needed guidance in many of their computer activities, and teachers often had to rely on parents, aides, or older students to provide this assistance. Other challenges that emerged during the first year of the K-2 implementation were addressed by the ESD189, including hardware specifications and training. These modifications had a significant impact on the success of the K-2 program during the second year.

As noted in the 2000-2001 evaluation report, clear patterns of use, benefits, and challenges related to technology integration at the intermediate and secondary levels have emerged over the past several years. After two years, such patterns are being uncovered

at the primary level as well. However, questions remain concerning the most appropriate hardware and software for young children, management strategies that are most effective in the primary classroom, and the potential of 5-8 year old children to use technology meaningfully, given their limited fine motor skills and reading abilities. Continued in-depth study of K-2 classrooms will help answer these questions, not just for the Teacher Leadership Project but for the entire educational community.

Additional Research and Evaluation Findings

The 2001-2002 TLP Evaluation Report focused on four key research questions. However, additional findings emerged and offer valuable insight into: (1) successes and challenges of an integrated curriculum; (2) the TLP training model; (3) the Understanding by Design framework, and (4) miscellaneous attitudes regarding educational computer technology. Each of these areas is discussed in the following section, and findings are again based on journal reflections, teacher interviews, and classroom observations.

Successes in Integrating Technology into the Curriculum

Although teachers often faced numerous challenges during their first year of integrating computers into the classroom, they reported important successes as well. These included changes in attitude and behavior, in student learning, and in the quality of work produced.

Attitude and behavior. One of the most often reported benefits of using technology for teaching and learning was the degree to which it impacted students' attitudes and behaviors. As in previous years most teachers found students to be highly motivated by having access to computers and related technology. Writing, research, and presentations were less formidable and less "boring" when students had word processing, the Internet, Encarta, and Power Point available. Motivation encouraged other positive behaviors, according to teachers, including perseverance, time on task, self-directed learning, and collaboration. Throughout the year, teachers cited examples of the inspiring influence of technology. For instance, having immediate access to information proved motivating enough to students that they often independently looked up answers to questions. The motivational aspect of computers is even more compelling when one considers Sternberg's contention (1998) that there is a relationship between motivation, meta-cognition and learning.

The hands-on nature of computers was also cited by teachers as having a significant impact on student's engagement and participation in the learning process. Composing, editing and publishing written work using computer technology proved far more appealing to students than using pencil, paper and a dictionary. The keyboard, the mouse, the screen, and the wide range of tools available on the computer provided ways for students to be constantly "engaged" in their learning. Numerous examples were shared in teacher journals.

I believe the level of motivation is higher when technology is available. Even if all I do is present my notes on PowerPoint, the students seem to be listening better and are more apt to take notes.

The most obvious success is the increase in motivation. Students willingly will search the net, watch slave videos on Encarta Africana . . . .

_____ is not a wealthy school district. Our library collection is less than extensive. One tremendous benefit for my students is the instant access to information! Even my most reluctant learners become engaged when they are working on the computers. That can't be bad!

Student excitement is at an all time high. After teaching my students how to create Power Point slide shows, one of my fourth grade boys went home and helped his dad spruce up his Power Point slide show he was going to present to his board of directors at work. My student showed his dad how to do background colors, slide transitions, and animations. Boy was my student "proud" and his dad "impressed!"

The students are "engaged" in their learning which keeps them highly motivated with less behavior problems. They are going to the computers to do research and not asking how or where to search. They are making choices to use Encarta or the Internet. They bring up word, excel, or power point and go right to work. Less time is wasted in the classroom, because there is always something going on and when students have completed a basic assignment, there is always a "long term" project to work on or applications to explore. I feel that they are enjoying school more and no one is bored, except those that choose not to participate.

The technology piece is richly motivating and engages even my lowest students or my least motivated. We often are using the technology to extend and support our learning. We have been able to find sites on the Internet that give real hands on experiences to things we are learning in our curriculum.

I see that my students are more excited to learn or do projects when we use technology. They stay focused on the task at hand.

My kids continue to enthusiastically participate in all learning projects . . . They would much rather do a project than engage in traditional read-discuss-answer the question learning experiences, and quite frankly, I don't blame them. As we have more experiences with the technology in my room (computers, projection device, and digital camera) the students are beginning to take more risks. One challenge I have found is that students would continue to work on the computer much longer than time allows us. I am glad when that means that students are highly engaged in their learning, but I struggle to balance that with the reality that I must plan learning activities that incorporate all elements in our curriculum and state standards.

Students continue to maintain high interest in anything related to technology. Their comfort level with the different applications and tasks has been enhanced, and they look forward to trying new things. There seems to be a higher level of confidence and greater ability to stay focused. Students have a more open approach to discovering ways to solve problems or to tapping a wider variety of resources. Students of differing academic abilities interact comfortably when working on a computer project. It is not always the brightest who know what to do.

Student motivation toward their learning still seems to be the best benefit of teaching with technology. I have to chase them out of the room sometimes. Their perseverance with finding information for their South America/Olympics PowerPoint project was amazing. We would list good sites on the board as we found them and we also shared with another 6th grade class that was doing a similar project but with I-movies.

Student learning. Although teachers were cautious in attributing academic gains to the addition of technology, some nevertheless sensed that their students were learning differently and learning more. In many cases teachers believed this was due to their increased exposure to information. As several explained it, if students are more motivated, more engaged, and spend more time on task, they must be learning more. Others remarked that the more they read, the better they read, and the more they write, the better they write, and since they do more reading and writing with technology, they must be improving in those areas.

I noticed that kids didn't have a picture in their minds of what percents are. So we did class surveys and then pie graphs on Excel. The next step was writing a paragraph explaining the graph to the class using percentages and fractions. I was surprised and amazed at the quality of the paragraphs. They showed a real understanding of the numbers. We did this at the beginning of the year with bar graphs just comparing information and with no percentages. What a difference!

I don't know for sure if we can link standardized testing to having technology in our classroom, but my students ITBS test results came back quite strong. I also tend to have higher percentages of students passing (with high grades) any of the tests we give in 6th grade. I think that by integrating tech into all areas, it gives the learning another modality through which it can be grasped. The biggest measure is with their attitudes though! They are always motivated to learn anything if we can involve technology. That is a huge win-win situation!

I have students who have taken the class before who tell me that the computer helped them understand a concept better than they had before. Some also found that using the computers made it more interesting and they could stay focused better. I have seen improvement in student understanding through improved test results. Since I concentrated on trying to develop more technology use in the

areas where I found particular weaknesses in past classes and used the same tests as before, I could see the improvement in those areas pretty clearly. When I present ideas in conjunction with Power Point visuals, the students seem to remember longer than when I just talk and write on the board. Generally, the use of technology, whether it's computers or graphing calculators, seems to provide a more active experience and the students seem to remember more easily and for longer periods than they do with just listening or reading. Though some students do learn better with the technology, it is important to remember that the use of technology actually adds to the stress of other students and it can actually impede their learning. It is important to "blend" tech and non-tech activities and to work with the students as individuals. After all, our ultimate goal is not to improve uses of technology in the classroom, it is to improve student learning by whatever means we have available. We need to improve all of our methods, those that involve technology and those that do not.

I believe the amount of technology in my room and the room next door (another TLP recipient), has increased the amount of learning that has occurred in my classroom this year. The students have access to a variety of types of technology that has helped out overall lessons throughout the year. Schoolkit, Webquests, Internet sites, have all helped enhance the lessons in the units I have done. The interest levels are higher and I believe the quality on the assignments has gone up.

I see the children learning in a different way using the technology. For some children it has given them strength in a new area. For others it has posed a challenge where perhaps they did not have too many challenges in the other types of learning that happens at school. I see children becoming more aware of their thoughts and actions as they enter information on the computers or work with new knowledge . . . I have also noticed that when the children are typing using MS Word, they are more aware of spacing, punctuation, grammar, and spelling. They are actively engaged in wanting to edit and self-correct their work. I truly see technology enhancing their learning, and I say this even though I have not even begun to utilize all that I learned this year.

I have almost completed the individual reading inventories on my students required by my district both at the beginning of the year and at the end. To my amazement, almost all of my students have gained two years of reading growth. A few have gained three and a few have gained the expected one year's reading growth. I attribute this reading growth to the amount of in-class research we have done on the Internet. Additionally, my class outperformed the other four sections of third grade on our district writing assessment. This writing expertise is tied directly to the writing my students have done in conjunction with their research projects.

Not all teachers were convinced that the addition of computers had a positive impact on student learning, however. Although they were definitely a minority, some felt

that while technology had an impact in other areas (motivation, information access, editing tools), there was no evidence to support learning gains.

> *In my opinion, the learning isn't necessarily any better; the product is improved because of the technology . . . The students currently in my room (4 of the 7 are working on computers) say that essentially their educational experience is the same. Their first response was "Yes" it is better, but when I asked them "why?", they changed to it being about the same. They did give me the internet access response though.*

Quality of student work. Teachers generally reported that student work was of higher quality when they had access to computers. Word-processing features, graphics, draw tools, the Internet, and spreadsheet and graphing capabilities allowed students to produce professional looking products. Not only were students proud of their accomplishments, but peers, parents, principals, and community member were also. Special needs students benefited in this regard as well. They were able to complete lessons and projects equal in quality to those of their more capable peers. The effect on their self-esteem and confidence was, in some cases, dramatic as the following excerpts illustrate.

> *The students that I service are all Special Needs students. They are used to being the "slow" or, to use their words, "stupid" studenst in the class. With the added confidence that they are getting from their growing competency on the computers they are becoming more self-assured and relaxed in the regular classroom setting. Also, by having the technology available for use at all times the students are able to turn in work that cannot be easily distinguished from their peers. This is very important to students at the middle school level.*

> *Many of my students have difficulty with the mechanics of pencil/paper but can keyboard quite well. This allows them to improve both the quantity and quality of the work.*

Again, while the majority of teachers reported that student work was of higher quality when they had access to computers, there were some who disagreed.

> *The quality of student projects is not what I would like. They like using the computers and are adept at finding information. Unfortunately, they don't like to take the time to really understand the information they get and to use it appropriately to create quality products. Things are improving in this respect, but there is still a long way to go.*

Challenges to the Integration Process

While teachers were overwhelmingly pleased with the addition of technology to their classrooms, their efforts to use it were not without challenges. Responses from the 2001-2002 cohort of TLP participants regarding the challenges to integration followed

the same general pattern as those from previous years and included technical problems, lack of technical support, lack of time for exploring and planning, network and server problems, student management issues (the 4:1 ratio), and space and wiring constraints.

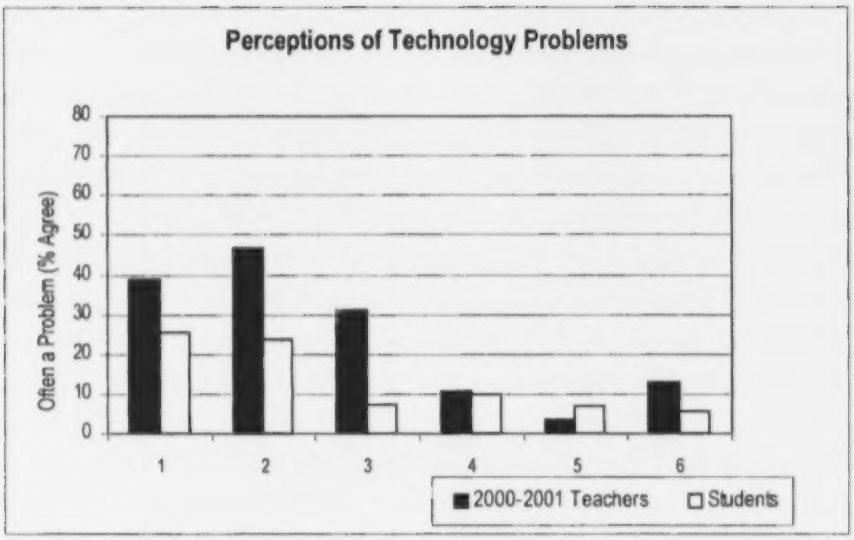
Hardware, software, and set-up challenges.

In the beginning of the school year, the major challenge for teachers was related to equipment rather than to curriculum planning, student management, or lack of time. Ordering issues, set-up problems and various technical glitches were among the most common difficulties they faced. Because most schools were not built and wired for multiple computers, many rooms required special wiring and/or construction of tables for the computers. A large number of teachers either purchased tables with their own money, or "scrounged" for leftover tables that weren't being used. Finding space for all the equipment was a hurdle as well. Again, the physical constraints of many classrooms did not allow for an ideal arrangement. Teachers were limited by the location of outlets or other built-in features. In many cases the computers had to be placed along one wall of the classroom which limited the amount of cooperative work that was possible.

Once the computers were set up, teachers were faced with any number of technical challenges, many that they were unable to fix on their own. Examples included malfunctioning printers, software problems, computers that would freeze or crash, and inconsistent district servers. Teachers with Macs were particularly vulnerable to network glitches. A number of teachers were plagued with laptop problems as well. As the year progressed, many of these problems were resolved, or at least became less frequent as teachers learned to address minor problems on their own. Network and server problems continued for many, however, and some participants spent the better part of the year dealing with NT 2000 issues and security barriers.

Survey responses provided additional insight into the difficulties teachers and students faced in the integration process as well (Figure 15), although survey responses do not match the degree of problems and frustration reported by teachers. Students in particular did not appear particularly troubled by technology issues. Of all the students who responded, only 26% felt that not having enough computers was "often a problem", and only 6% reported that they "often" did not have enough relevant software. Teachers found these issues somewhat more difficult but still not to the degree that was reported in journals. Less than half felt that not enough computers (39%), not enough time to use the computers (47%), or lack of room to use computers (31%) caused a problem "often."

Figure 15



1. Not enough computers
2. Not enough time to use computers
3. Not enough room to easily use computers
4. Unreliable / broken computers
5. Internet is not easily accessible
6. Not enough relevant / appropriate software

Excerpts from their journals were helpful in understanding the various hardware and set-up challenges.

> *Wanted to get iBooks or iMacs, but district said no. Too bad. Would have been a much better fit in my room, computers would have few problems than they do now with wireless access and smaller footprint, and they would be much less cumbersome and easier to use. Microsoft software may be able to do a lot, but if it is not reasonable for children to use it then it is not a tool; and it is also very unreliable. TLP should mandate that teacher be able to determine what goes into classroom, especially when teacher knows best. Took a lot of wind out of the sails and I wish I never did it.*

> *Many technical difficulties. One of my computers doesn't work. They never seem to shut down properly. We never know when the printer will work, or which computers will print. [My laptop] freezes up all the time. I have had to call the HP tech support hotline because it read every document as a Paint file.*

Navigating the Windows 2000 network and trying to share files with the students is often a problem.

Class sizes (are) inflated by district after first year of TLP project.

To this point, I have not had all of my computers working at the proper capacity. I can't write down all of the issues I have had to deal with, but I will honestly say I have shed tears out of absolute helplessness and frustration!

Technical support. The struggle teachers face in getting adequate technical support continues, and is one of the most significant barriers to effective computer integration. While they are given some tips in solving technical problems at their training sessions, most teachers are not skilled in trouble-shooting the more complex or unusual glitches and are thus left waiting for school or district personnel to assist them. This is understandably frustrating as it means that planned lessons or presentations must be cancelled or projects postponed until help arrives. Teachers feel especially disillusioned about the lack of support since the TLP grant stipulates this as a requirement of participating districts. The following comments from journals and interviews are representative of teachers' remarks over the course of the school year.

District control, no on-site support and unreliable district support availability is a significant problem. Our district take on building support is to maintain control over all machines. However they do not have the staff through which to provide support and have also made it so the user cannot troubleshoot and problem solve.

Not having enough technical assistance is often a problem.

Most problems derive from technocrats whose needs to control technology too often supercede instructional needs. A month ago we faculty finally forced a meeting with the technology chief to begin a dialogue. However, the dialogue has only begun.

Filters on our Interent system make research a pain sometimes. They want us to send a slip in to Info Tech Help desk EVERY time a student gets a denied access warning if we want to use that site, and we have to justify why the site is valuable. That is a paperwork nightmare and a barrier to learning.

Our district doesn't provide the support that is needed to keep these computers up and running on a daily basis. Wiring problems, printer problems, log-in problems are to name a few of my frustrations with tech support.

Very poor tech help from the district.

District networks that lock you out and then district answers are two or three weeks after you've requested help.

Student management. Managing students and computers at a 4:1 ratio also proved challenging to teachers. For elementary teachers, finding ways to monitor and assist students working on the computers while continuing to deliver instruction was difficult. Finding enough computer time for multiple classes of students within 50-60 minute blocks of time was the struggle for secondary teachers. Second, third and fourth year teachers found ways to make the ratio work, but a significant number said the process would be much more efficient and effective with a 2:1 ratio.

> *Well, you'd think having 7 computers in the classroom would alleviate this problem, but fair time use for all students/sharing is still a challenge for me. I still haven't come up with a management system that is fair and easy to implement.*

> *There are many activities that get cut short or left out because we can't take the time that is required for each student to spend time on the computers with the 4 to 1 ratio. We struggle with doing everything as groups or less as individuals in order to fit it into our schedule. We would definitely use them more if we could all use the computers simultaneously instead of having to provide other assignments for those who are waiting.*

Time. As teachers from previous TLP cohorts have reported, there is never enough time to do the exploring, planning, and refining they feel is necessary. Nearly every teacher commented on the time constraints involved in implementing an integrated program, including the increased length of time to do projects with technology, not being able to get through required curriculum, lack of time to create and adapt lessons with technology, and time to learn the various software programs. The need for more time continued to frustrate them over the course of the year, and to some degree during the second year as well. To a certain extent this is the nature of teaching. However a time-intensive program like the TLP intensifies this demand, especially during a teacher's initial attempts.

> *I haven't had enough time to collaborate with co-workers on developing plans, nor have I had enough time to share what I have learned with the rest of the faculty*

> *Not having enough time for myself to figure out ways to use the computer and work through my ideas myself. More teacher planning time is needed.*

> *Time itself to prepare "good" assignments and projects. It seems like after the fact I realize what I should have done, but I must get ready for the next day. That is frustrating. Book and paper work was easier to do, but not as exciting and in many cases as affective. The tech projects and assignments are great when done well, they are exciting and effective, but they take time to set up. Time, Time, Time.*

TIME -- having enough time to do the kind of planning that would lead to the most successful use of the technology and curriculum planning.

Miscellaneous challenges. While the most significant challenges to technology integration were hardware issues, lack of technical support, and lack of planning time, there were other challenges as well. First, while it is mentioned less often every year, the amount teachers and students are able to accomplish is related to some degree to students' keyboarding skills. This is particularly true in classrooms where lessons involve a significant amount of word-processing. However, as more and more students receive keyboard instruction in the elementary grades, this limitation becomes less troublesome.

Another challenge for teachers was related to the reform efforts taking place in Washington state. Many districts and schools are adopting curricula that are more directive and explicit, that require large blocks of time, and that allow minimal opportunity for teacher flexibility. Teachers in these situations reported that they were necessarily limited in what they could do with the technology.

Time is always the biggest challenge. Our required 90 min. of reading and 90 of math are not conducive to integration of any kind. I do occasionally integrate technology with my reading students, but because they are not with me throughout the day to continue projects, work on them in their "free time", etc. it is hard to do. Integrating technology requires that all students have access and not just during the "reading time."

Our school has committed ourselves to two hours of a reading program each day in a block schedule. After you factor in PE, Library, and Music, it doesn't leave much time to do elaborate or complete lengthy computer projects. I have, however, found ways to integrate smaller lessons into my math, social studies and science. I try to focus on the objective of the lesson and simpler ways to integrate computers rather than having a project determine what the outcome is.

The TLP Training Model

First year TLP participants were asked to respond to the following question: "What aspects of your TLP training have been useful to you as you've integrated technology into the curriculum? What additional training would be useful?" Teachers' responses were overwhelmingly positive and enthusiastic. They found their summer training sessions to be intense, yet valuable. Hands-on learning projects, sharing sessions, practical instruction in using programs, and student management strategies were some of the highlights they noted. Help desks and "tech tips" also received positive reviews. Follow-up sessions proved useful as well, and teachers were appreciative of the time they were given to talk, share, and collaborate in developing lessons. Many felt this was more useful that instruction on programs. It was not uncommon for teachers to comment on the

rigorous and professional nature of the training sessions, and more than a few suggested it was the best in-service they had ever experienced.

Support can be found in the literature for several components of the TLP model including the focus on curriculum, in-depth training, and funding for hardware and software. Critical conditions for success include a focus on curriculum and pedagogy (Becker, 2000; Earle, 2002; Pierson, 2001; Salomon, 2002); time for collaboration (Earle, 2002; Eastwood, Harmony & Chamberlain, 1998; Windschitl & Sahl, 2002 and training by practitioners (Eastwood, Harmony & Chamberlain, 1998; Salomon, 2002). According to Ertmer (1999), "Teachers need opportunities to observe models of integrated technology use, to reflect on and discuss their evolving ideas with mentors and peers, and to collaborate with others on meaningful projects as they try out their new ideas about teaching and learning with technology" (p.54).

Excerpts from journals and interviews reflected the sentiments of TLP participants regarding their training.

> *The technology training has been very, very helpful. This last session was especially helpful. It seemed to be more individualized, time was given to work in groups, and I learned allot from the sharing time from other participants.*

> *TLP training has been the foundation of all that we have accomplished! Each two day conference answers questions and asks more. The Help Desks are extremely useful...as I usually pick something that I need right then. New ideas and sharing with other teachers is so beneficial. More training? Need more time to plan projects and learn new methods for incorporating the computer. More weekends next year would be great.*

> *Everything and everyone have been extremely helpful. My sessions . . . were packed with information. I wouldn't be where I am today with computer knowledge if the training hadn't been made available. I say this with the utmost of enthusiasm; this has been an incredibly exciting year for my students and me. Time was the biggest limiting factor; I assure all involved I will do my part in keeping the excitement alive.*

> *All of the training has been invaluable to me since I could do little except answer e-mail and word process prior to TLP. I have learned so much and I am proud to empower my student with the knowledge I can now share with them.*

Teachers stated that they would like additional training in solving technical problems, which was not surprising given the lack of support many experienced. A number of teachers suggested that the TLP devote more time during summer and follow-up training sessions to technical support issues. Their reasoning was that "if the district isn't going to come through and help me, I would like to be able to help myself." Aside from additional technical training, teachers felt that more instruction with video editing,

digital cameras, and scanners would be useful, as would help using Front Page, Excel, and web page design.

Components of a Successful Program

Across grade levels and across years in the program, teachers consistently identified three essential elements of a sound technology integration program. These were: (1) Comprehensive initial training; (2) Adequate technical support and (3) Follow-up training. Teachers' opinions about the first year training sessions and the lack of technical support they received have already been discussed. And while they were unquestionably positive about the TLP training they received; they were disillusioned by the fact that it would not be continued into the second year. As in previous years, many commented that after a year in the project they were just getting a sense of the "big picture" of technology integration. In a sense, teachers spent much of the first year laying the groundwork for what they were trying to do, and only then did they feel prepared to address the more practical and specific aspects of an integrated program. This sentiment was true of new participants as well as those who had been in the program for several years. As one 4th year TLP commented, "After the first year we felt like we had been abandoned."

The need for extensive and ongoing training is supported in the research literature. Franklin, for example, believes that perhaps "the greatest challenge of training lies in recognizing that the need for it never ends. Just as computers and Internet connections require continual upgrades to function at their best, human resources must also be updated to stay current and functional" (2001, p.5).

> *. . . I wish that our training would continue – I feel like I am on a learning curve (and that I am more ready now than I was at first to start having my kids make use of some of the programs).*
>
> *All aspects of my training have been useful, though some of it I would like to try again, now that I am more comfortable with my computer. You can only absorb so much at a sitting, and much of what was taught went right over my head. I don't know if I will ever feel comfortable in EXCEL. The help desks and lessons at the last weekend training session were great, and I suspect part of that was because I have a greater familiarity with what in heck is going on! So I would appreciate doing some of the things over again so I could get what I missed the first time.*
>
> *TLP has done very little in way of support for year 2ers. This is ridiculous. We signed on for a 3 year grant yet their is no support . . . .*
>
> *Follow up training in our K-2 band would be most helpful. (Review & sharing ideas.)*

I wish that an additional summer session was available this year. We spent the first summer learning the hardware and the follow-ups sharing ideas and developing a unit, I feel ready to now get down to work to really develop some additional units for next year. It would be nice to have the time to work and also have the technical support.

Understanding by Design

The Understanding by Design curriculum framework was given greater emphasis in TLP summer training sessions and follow-up meetings during the 2001-2002 school year. This was done in an effort to help teachers develop substantive integrated lessons that focused on the curriculum and not just on the technology. Analysis of journal responses revealed a wide range of opinions on the usefulness of the UBD framework and of the appropriateness of including it in the TLP training. Teachers' responses can be categorized as follows: (1) teachers who appreciated UBD and used it in their planning; (2) teachers who appreciated the framework but did not have time to use it in planning, or whose district used a similar framework; (3) teachers who were already familiar with the principles of UBD and felt the training was an unnecessary and an unproductive use of TLP time and (4) teachers who did not agree with the basic UBD philosophy and did not use it. While slightly more teachers indicated they were *not* using the framework, this was often because they found it too time consuming or because they already used a similar framework. Still, there were a number of teachers who felt that "good teachers do this naturally" and that the time could have been better spent in other ways.

Teachers who did choose to use the framework generally found the overarching questions and essential questions, the GRASPS design, and the backward design methods most beneficial. The rubrics were also used for assessment. Many participants planned to spend time over the summer months designing curriculum units using concepts from Understanding By Design.

The following excerpts from journals are representative of the wide range of opinions teachers held about Understanding by Design.

At this point I have adapted the Understanding By Design framework into three parts and I try to put every unit and concept through the test. Step one I determine the outcomes that I want students to retain. Next I plan how to evaluate the students' work and whether or not they have achieved the objective, and last I plan activities that are engaging, but designed for a specific purpose. It has really changed how I approach all of my lessons, whether they involve the use of technology or not. In the beginning I was a little overwhelmed with the process, because it seemed so cumbersome that I was a little intimidated to try to plan a unit, but now that I have looked at it in a more simple way I am able to use it frequently.

I LOVE UBD! I have been using the UBD framework for each new unit I have designed since I first started learning about it in my regional meetings. My

ultimate goal is to have every unit designed with the framework. When I design my lessons this way, I feel more focused on what to teach, and find it easier to integrate technology with a purpose.

For me the Understanding by design has been a saving factor in all my teaching, not just integrating technology. I am redesigning all my curriculum for next year using the UbD templates. I don't feel like I'm making it up as I go along and I have really taken a hard look at the activities I've done in the past to see how it fits into the larger scheme of things. I've also tossed out boxes of "clutter" I've saved from previous years of teaching.

The book has been helpful in making more sense out of how to determine student learning and what standards to target during any given activity. The backward design has become more and more clear over time, and I can make more sense out of how to use it than I did at the beginning of our training. Being completely honest, I cannot say that I use it readily for all my projects, but I am beginning to use it more and more. In addition to all of this, through various conversations with my school principal and formal observations she has done on me throughout the year, she has become more aware of what the book entails and how I have begun to use it to guide my practice in the classroom. She even had us purchase a copy of the book for the school in hopes that with our lab being set up for next year, people will use the modules from the book to design activities and projects on the computers.

I haven't specifically used it as we have been working on "backwards planning" in our district for the last three years. Further, my master's program was all backwards planning, although it wasn't labeled that. In fact, I found it difficult at first to think this way, only because of the name. This way of thinking is frontwards to me! Doing anything else would be difficult and backwards.

I use this very little. This was probably the one thing that I use the least from my classes and follow-ups. I teach Physics and Chemistry and next year will teach Human Anatomy and Physiology. I do develop lessons planned upon what I want students to learn but since I do not have to follow state standard I have not seen that teaching to the tests (as UDB advocates) as particularly useful.

To be honest, I really don't think too much about the Understanding by Design framework when I plan my lessons. This framework is nothing new as far as I'm concerned. I think that all effective teachers decide what they want their students to know, plan engaging lessons and develop appropriate assessment tools to check for understanding. Isn't that good teaching? I guess I was a little insulted that I was even given this book with the intent that I was going to spend valuable time reading about something that is so basic to teaching.

The Understanding by Design book was a complete waste on me. It has helped in the sense that I now think more of the overarching questions I want

students to answer throughout or at the end of a unit. Otherwise, the program seems so time consuming and laborious. I don't have the time to spend 60 hours planning each and every unit that I do with the children. Just trying to read through the book is a chore. It seems like a wonderful program that would work well for many people, just not for me.

The Future of Technology Integration

While most teachers limited their journal responses to the specific questions provided, others reflected on the more wide-ranging issues inherent in implementing an integrated curriculum and on the long-term potential and challenges of such efforts. One of the primary concerns expressed by third and fourth year TLP teachers was related to the maintenance and replacement of equipment. Computers, printers, laptops, cameras and even software that were part of the original TLP grants are showing signs of wear and tear, and teachers face the challenge of replacing or repairing what they have. The TLP grant stipulates that districts make a three-year commitment to provide support. After that, they can determine their own level of support. Depending on their commitment to support a technology agenda, TLP equipment may or may not be replaced. Several fourth year teachers shared examples. According to one, "My laptop has been in the shop since last Fall and my presentation device is broken. I don't know when I'll have them back. This does make the whole process harder." Or, as another reported, "The laptop is critical to effective integration, but mine is broken and there is no way to fix it. There is a lack of support at both the school level and the district level." Second year teachers were in better shape, but some expressed concern at the prospect of slowly losing their equipment. Clearly a district's financial and philosophical commitment to a rigorous technology agenda will impact many TLP classrooms in the coming years.

I think my view of integrating technology into the curriculum has changed this year. Our building and district have been undergoing budget constraints and reductions. Our file server in our building is going to die soon... only a matter of time, and then there is no money to replace it. Also, I ran into some limits with the memory of the i-Macs that makes me wish I had gone PC! Consequently, my kids have been restricted in the amount of PowerPoints or images that we save, and have been less adventurous than last year. I think that I have been more conservative in my lesson designs also. I integrate the technology, but found out in year one that it doesn't always make things easier or better!

The use of groups of three or four students is difficult. Each student wants more time on the computer. This is not possible. The timing of computer use is carefully monitored so that each student is able to have enough time to create his or her part of the project. I have other computers in the classroom that are slower and not multimedia. We use these for research and writing. However, as these begin to fail, the district tech services are not fixing them. They are outdated and not worth the effort.

The problem of integrating still lies in how to get all the kids through the tech stations or tasks. Managing behaviors and decisions on who and how to use the tech still creates conflict. More stations are needed and a budget to replace software is a huge need. Small districts such as mine, struggle with how to handle this when things like roofs and playgrounds need attention.

Summary

The evaluation of the Teacher Leadership Project focused on four primary research questions regarding teachers' efforts in implementing an integrated technology curriculum. However, journals, survey responses, and interviews provided valuable insight into other aspects of the TLP including successes, challenges, key elements of a sound program, and teacher perceptions of the Understanding by Design curriculum framework. Teachers counted many successes in their integration efforts, most often related to changes in student attitude and behavior, student learning, and quality of student work. There were challenges as well, most notably problems with equipment, lack of technical support, and lack of time to explore programs and plan lessons.

Teachers were positive about the training they received through the Teacher Leadership Project, and specifically noted the value of hands-on projects, opportunities to share and collaborate, and "help desks." On the other hand, reaction to the UBD component of the TLP training was mixed. Some teachers felt that it had enhanced their efforts while others felt that it was not a good use of time.

The need for sound training was considered one of the most important elements in a program such as the TLP, followed closely by adequate and timely technical support and continued training. Again and again teachers expressed a need for a second year of TLP training sessions.

CONCLUSIONS AND RECOMMENDATIONS

The Teacher Leadership Project administered by the Northwest ESD 189 provides K-12 teachers in Washington state with the necessary training and equipment to support the integration of technology into the curriculum. The TLP model also supports and encourages teachers to share their knowledge and expertise with colleagues within and beyond their immediate schools and districts. The evaluation of the TLP was designed to ascertain the extent to which these goals were met during the 2001-2002 school year. Data were gathered from several different sources to address the four evaluation questions and included reflective journals from teachers, teacher interviews, classroom observations, and Technology Use Surveys for both teachers and students.

Findings revealed that the Teacher Leadership Project is a remarkably effective training model that embraces many of the conditions identified in the literature as being critical to successful integration including in-depth training, a focus on curriculum, and funding for hardware and software. The instruction and materials were well-received by teachers, administration of the program was organized and efficient, and participants were motivated to use their knowledge and skills. While there were many challenges in implementing a program such as the TLP, teachers were generally convinced that the benefits were worth the effort.

The impact on students was significant according to teacher reports. Attitudes, behaviors, learning, and work products were all improved because of the opportunities afforded by a rich-technology environment. Specifically, when computers were added to the classroom teachers often saw student growth in reading, writing, and problem-solving skills, and in their abilities to conduct research. Students were more motivated, more self-directed, more on-task, more likely to participate, more collaborative, and more interested in school when they had access to technology. Teachers suggested that these factors contributed to student engagement and thus to student learning. Real world connections made possible by computers and the Internet were viewed as one of the most powerful applications of an integrated curriculum. The availability of current and "virtual" information brought the "world to their fingertips."

Teachers expressed frustration at the lack of technical support they received from their districts, especially since the TLP grant stipulated a certain level of support. They had limited experience in solving technical glitches and were often left waiting for assistance from district personnel, in the meantime canceling lessons or postponing technology-dependent projects. Teachers also struggled to find time to integrate technology in a meaningful way. Exploring the various applications and planning integrated lessons are time intensive tasks, and teachers frequently felt that they were "barely keeping their heads above water."

A goal of the Teacher Leadership Project is to support and encourage teachers to be leaders in the area of technology integration. Results of the evaluation suggested that teachers were indeed sharing their training with others in a variety of different ways including providing in-services to building and district colleagues, serving on building and district technology committees, providing technical support to their peers, and making presentations at professional conferences. Their contributions to the profession were many, and because of their efforts the TLP is having an impact far beyond the core group of participating teachers.

Nearly all teachers reported satisfaction with the training they received through the Teacher Leadership Project. They felt the instructors were well-prepared, knowledgeable, understanding, and supportive, and they appreciated the balance of direct instruction and hands-on projects. As in previous years, teachers noted the need for ongoing (second year) training. To their credit, ESD 189 did provide limited continuing education opportunities for "veteran" participants, although many teachers seemed unaware of them.

In an effort to understand the appropriate place of technology in K-2 classrooms, the in-depth study of technology integration at the primary level continued during the 2001-2002 school year. Patterns of use are emerging which look somewhat different than those found in studying intermediate and secondary classrooms. In fact, there was notable variation in how kindergarten, first, and second grade students used computers. One of the most important findings was the degree to which teachers found technology useful for instruction and demonstration. In some cases computers and related technologies were used at least as often by the teacher as they were by students.

Third and fourth year teachers remained generally positive about the potential of computers to improve teaching and learning. With time comes experience, and with experience they found that integration becomes more natural. In addition, teachers reported that over time they found it easier to focus their efforts on student outcomes rather than on the technology. Veteran teachers continued to experience technical problems and were more often confronted with maintenance and replacement issues.

TLP teachers made significant progress in finding effective and relevant ways to enhance student learning with technology. While it took time to find a comfortable balance, and while they faced numerous challenges in the process, the benefits for teacher and for students were impressive.

Recommendations

1. The Teacher Leadership Project has evolved into a strong, replicable model for supporting teachers in their efforts to enrich teaching and learning with technology. The content, the instruction, and the support provided to first-year participants during the initial summer training sessions and subsequent follow-up sessions are key to the program's success. The TLP administration continues to

strengthen the integrity of the model with its focus on curriculum development and the work of Wiggins and McTighe. Research literature supports the philosophical position of ESD189 in asserting that curriculum development is at the heart of any educational program, and thus even though reactions from teachers were mixed it is recommended that the program continue to emphasize curriculum development.

2. Teachers are an important resource to the Teacher Leadership Project, and the practice of involving them in the program as instructors, assistant instructors, screeners of prospective participants, and presenters across the country is commendable and accounts for much of the program's success. Certainly the Teacher Leadership Project should continue to involve teachers at all levels.

3. Research suggests that while educational innovation and restructuring are relatively simple to embrace, they are much more difficult to institutionalize. In fact, experience indicates that three to five years of support and continuing education are often necessary for a given reform to become part of the school fabric. "Perhaps the greatest challenge of training lies in recognizing that the need for it never ends. Just as computers and Internet connections require continual upgrades to function at their best, human resources must also be updated to stay current and functional" (Franklin, 2001, p.5). Responses from veteran TLP teachers supported this view. Continued training, sharing, and collaboration opportunities beyond the first year could serve to strengthen the efforts of the Foundation, the ESD189, and the Teacher Leadership Project.

4. Technical support continues to be one of the major barriers in teachers' efforts to successfully integrate technology into the curriculum. The TLP should continue their efforts to strongly communicate and reinforce the technical support criteria to prospective participants, their administrators, and their participating districts.

5. Leadership is an important component of the TLP model, and the manner in which it is modeled and supported at the training sessions is impressive. Publishing a list of relevant presentation and publication opportunities would be another way to encourage teachers' leadership skills and also to expand the influence of the TLP.

6. Despite continuing efforts on the part of the Northwest ESD to reinforce district and school support of TLP grantees, inadequate technical support remains a frustration for many teachers. Including basic technical support tips in the summer and follow-up training sessions would provide teachers with some means of self-support.

7. Although many teaches have worked hard to spread the word about the Teacher Leadership Project, some participants question the extent to which parents and community members are aware of the program. Teachers should be encouraged

to share their work and the work of their students beyond the walls of the classroom.

8. As the Teacher Leadership Project model becomes more widely known and requests for information about the program increase, there is the likelihood that requests for opportunities to visit "best practice" classrooms will increase as well. Developing a list of such classrooms across Washington state would be a useful step in promoting and extending the influence of the TLP.

Specific recommendations regarding the K-2 component of the Teacher Leadership Project include the following:

9. Efforts made by the Northwest ESD to adapt training sessions to the specific needs of K-2 teachers were well-received. Such modifications should be continued, with special attention given to the unique requirements of kindergarten teachers.

10. Given the findings of the usefulness of the document camera and projector, continue to specify these as requirements for the K-2 teachers.

11. Evaluation findings suggest that the use of technology can differ significantly even within the K-2 grade span, given the wide variability in 5-8 year-olds' developmental abilities. When selecting new K-2 participants, consideration should be given to the grade and skill level of students, and to the most appropriate hardware configuration for each situation. A stratified selection process would be reasonable.

12. One of the primary concerns of K-2 teachers has been the dearth of high-quality, developmentally appropriate software to which they have access. Identifying, testing, and sharing potentially useful "primary" programs and applications with K-2 teachers in all TLP cohorts should be an intentional and ongoing goal of the program. The TLP website and list serve would be excellent avenues for sharing this information.

REFERENCES

Allen, R. (2001). Technology and learning: How can schools map routes to technology's promised land? *Curriculum Update,* 1-8. Fall, 2001. # 101297.

Becker, H. (2000). *Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban right*? Revised paper written for the January 2000 School Technology Leadership Conference of the Council of Chief State Officers, Washington, D.C.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (Eds.) (1999). *How People Learn: Brain, Mind, Experience, and School.* Washington D.C.: National Academy Press.

Brown, C., Fouts, J. & Rojan, A. (2001). *Teacher Leadership Project 2001 evaluation report.* Mill Creek, WA: Fouts & Associates. http://www.gatesfoundation.org/education/researchandevaluation/default.htm

Clements, D.H., Nastasi, B.K. & Swaminathan, S. (1993). Young children and computers: Crossroads and directions from research. *Young Children,* January.

Cordes, C., & Miller, E. (Eds.) (2000). *Fool's Gold: A Critical Look at Computers in Childhood.* College park, MD: Alliance for Childhood.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York: Teachers College Press.

Cuban, L. (2000). *So much high-tech money invested, so little use and change in practice: How come?* Paper prepared for the Council of Chief State School Officers' annual Technology Leadership Conference. Washington D.C. (January).

Duffy, T.M., & Cunningham, D.J. (1996). Constructivism: Implications for the design and delivery of instruction. In D.H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (p.170-198). New York: Macmillan.

Eastwood, K., Harmony, D. & Chamberlain, C. (1998). Integrating technology into instruction: How we became one of the best by simply listening. *Curriculum Technology Quarterly, 7* (3), 1-6.

Earle, R. (2002). The integration of instructional technology into public education: Promises and challenges. *Educational Technology, 42* (1), 5-13.

Ertmer, P. (1999). Addressing first and second order barriers to change: Strategies for technology implementation. *Educational Technology Research and Development, 47* (4), 47-61.

Fouts, J.T. (2000). *Research on computers and education: Past, present and future*. Seattle, WA: Bill & Melinda Gates Foundation. http://www.gatesfoundation.org/reports.html

Fouts, J.T. & Stuen, C. (1997). *Copernicus Project: Learning with laptops. Year 1 evaluation report.* Seattle, WA: Seattle Pacific University (ERIC Document Reproduction Service No. ED 414847).

Fouts, J.T. & Stuen, C. (1999). *Teacher Leadership Project evaluation report*. Seattle, WA: Seattle Pacific University. http://www.gatesfoundation.org/learning/ed/profdev/tlp/evals

Franklin, J. (2001). Teachers and technology: Turning the corner on training. *Curriculum Update,* Fall, 2001, pp. 4-5. ASCD.

Fullan, M. (2000). The three stories of education reform. *Phi Delta Kappan, 81* (8), 581-584.

Gatewood, T. & Conrad, S. (1997): Is your school's technology up to date? A practical guide for assessing technology in elementary schools. *Childhood Education, 73*(4), 249-251.

Goldberg, L. (2002). Our technology future: If we're wired, why aren't we transforming learning? *Education Week, 21* (27), 32-34.

Haugland, S.W. (2000). Early childhood classrooms in the 21st century: Using computers to maximize learning. *Young Children*, January.

Haugland, S.W. & Wright (1997). *Young children and technology: A world of discovery*. New York: Allyn & Bacon.

Haugland, S.W. (1999). What role should technology play in young children's learning? *Young Children,* November.

Healy, J. (1999). *Failure to Connect.* New York: Touchstone.

Hopson, M., Simms, R. & Knezke, G. (2001-2002). Using a technology-enriched environment to improve higher-order thinking skills. *Journal of Research on Technology in Education, 34* (2), 109-119.

Johnson, D. & Johnson, R. (1989). *Cooperation and competition: Theory and research.* Edina, MN: Interaction Book.

Kearsley, G. (1998). Educational technology: A critique. *Educational Technology, 38* (2), 47-51.

Lowe, J. (2001-2002). Computer-based education: Is it a panacea? *Journal of Research on Computing in Education, 34* (2), 163-171.

Means, B. (Ed.) (1994). *Technology and Education Reform. The Reality Behind the Promise.* San Francisco: Jossey-Bass Publishers.

Meyer, L. (2001). New challenges. *Education Week, 20* (35), p. 49-54.

NAEYC (1996). Technology and young children --ages 3 through 8: A position statement. *Young Children, 51*(6), 11-16. http://www.naeyc.org/resources/position_statements/pstech98.htm

NAEYC and NAECS in State Departments of Education (1991). Guidelines for appropriate curriculum content and assessment in programs serving children ages *Young Children, 46*(3), 21-38.

NCES (National Center for Education Statistics) (2000). *Teacher's tools for the 21st century: A report on teachers' use of technology.* Washington D.C.: Office of Educational Research and Improvement. http://nces.ed.gov/pubsearch

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 33*(4), 413-430.

Roblyer, M.D. & Edwards, J. (2000). *Integrating Educational Technology into Teaching.* Upper Saddle River, N.J.: Merrill/Prentice Hall.

Salomon, G. (2002). Technology and pedagogy: Why don't we see the promised revolution? *Educational Technology, 42* (2), 71-75.

Shaw D.E. & the President's Committee of Advisors on Science and Technology Panel on Educational Technology (1998). Report to the President on the use of technology to strengthen K-12 education in the united States: Findings related to research and evaluation. *Journal of Science Education and Technology, 7*(2), 115-126.

Sherry, L., Billig, S., Jesse, D., & Watson-Acosta, D. (2001). Assessing the impact of instructional technology on student achievement. *T.H.E. Journal.* February http://www.thejournal.com/magazine/vault/A3297.cfm

Sivin-Kachala, J. & Bialo, E. (1995). *Report on the effectiveness of technology in schools 1990-1994.* Washington D.C.: Software Publishers Association.

Skinner, R. (2002). Tracking tech trends. *Education Week, 21*(35), p. 53-56.

Slavin, R. (1989). Cooperative learning and student achievement: In R.E. Slavin (Ed.), *School and classroom organization* (129-156). Hillsdale, NJ: Erlbaum.

Sternberg, R. J. (1998). Abilities are forms of developing expertise. *Educational Researcher, 27*(3), p. 11-20.

Stuen, C. & Fouts, J. (2000). *Teacher Leadership Project 2000 evaluation report.* Seattle, WA: Seattle Pacific University. http://www.gatesfoundation.org/learning/ed/profatesfoundation.org/learning/ed/profdev/tlp/evals

Tiene, D. & Luft, P. (2001-2002). Classroom dynamics in a technology-rich learning environment. *Leading and Learning with Technology, 29* (4), 1-6. http://www.iste.org/L&L/29/4/featuredarticle/tiene/index.html

United States Department of Education (1993). *Using Technology to Support Technology Reform.* Washington D.C.: Author. http://www.ed.gov/pubs/EdReformStudies/TechReforms/

Van Scoter, J., Ellis, D. & Railsback, J. (2001). *How technology can enhance early childhood learning.* http://www.netc.org.org/earlyconnections/byrequest.html

Windschitl, M. & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal, 39* (1), 165-205.

APPENDIX A
Technology Use Survey for Teachers

Technology Use Survey: Teachers
Teacher Leadership Project

Section 1: General and Demographic Information

1. Name _____
2. Grade Level:
   ☐ K-2 ☐ 3-5 ☐ 6-8 ☐ 9-12
3. Primary subject area (middle/high school teachers)
   ☐ Language Arts ☐ Math ☐ Science ☐ Social Studies
   ☐ Technology ☐ Fine Arts ☐ P.E. ☐ Foreign Language
   ☐ Other _____
4. Gender (not required)
   ☐ Male ☐ Female
5. TLP Cohort
   ☐ 2000-2001 ☐ 2001-2002

Section 2: Impact of Technology
Mark the response that most closely identifies the extent to which you believe technology has influenced each of the following elements of teaching, learning, and the classroom environment.

	Strongly Agree	Agree	NA/Unsure	Disagree	Strongly Disagree
1. Student attendance is better.	5	4	3	2	1
2. There are fewer discipline problems.	5	4	3	2	1
3. Students complete more homework.	5	4	3	2	1
4. Students are more interested in school.	5	4	3	2	1
5. Quality of student work is better.	5	4	3	2	1
6. Lesson planning is easier.	5	4	3	2	1
7. Student motivation is higher.	5	4	3	2	1
8. Parents are more involved in their child's learning.	5	4	3	2	1
9. Scores on traditional tests are higher.	5	4	3	2	1
10. Students are better problem-solvers.	5	4	3	2	1
11. Students are more collaborative.	5	4	3	2	1
12. Students are more frequently on-task.	5	4	3	2	1
13. Students are more self-directed in their learning.	5	4	3	2	1
14. Management of students is easier.	5	4	3	2	1
15. More time is available to help individual students.	5	4	3	2	1
16. Assessment of student work is more accurate.	5	4	3	2	1

Section 3: Technology and Instruction
Mark the response that most closely identifies your perception of your integration efforts.

	Strongly Agree	Agree	NA/Unsure	Disagree	Strongly Disagree
17. It would be difficult to accomplish my learning objectives and goals without the technology.	5	4	3	2	1
18. Technology integration in my classroom improves student learning.	5	4	3	2	1
19. Technology integration has changed my role as a teacher.	5	4	3	2	1

20. Students in my classroom focus on learning, not on the technology.	5	4	3	2	1
21. I can easily explain how technology improves or enriches any lesson in which it is used.	5	4	3	2	1
22. Integrating technology into the curriculum is a natural component of my teaching.	5	4	3	2	1

Section 4: Student Technology Use at School
Mark the response that most closely matches your use of technology.

To what extent do your students use computers for each of the following types of activities?

	Not at all	Little Use	Moderate Use	Extensive Use
	1	2	3	4
23. Practicing skills (math facts, etc)	1	2	3	4
24. Solving problems/analyzing data	1	2	3	4
25. Word processing	1	2	3	4
26. Creating graphs	1	2	3	4
27. Presentations and/or demonstrations	1	2	3	4
28. Research using the Internet/ CD ROM	1	2	3	4
29. Communication using e-mail / Internet	1	2	3	4
30. Drawing/artwork	1	2	3	4
31. Other _____				

How much of a problem is each of the following in your classroom?

	Not a problem	Seldom a problem	Often a problem
	1	2	3
32. Not enough computers	1	2	3
33. Not enough time to use the computers	1	2	3
34. Not enough room to easily use the computers	1	2	3
35. Unreliable/broken equipment	1	2	3
36. Internet is not easily accessible	1	2	3
37. Not enough relevant/appropriate software	1	2	3
38. Other _____			

Section 5: Leadership Activities
Please indicate any/all areas in which you have taken a leadership role since receiving your TLP grant.

39. Building classes / inservice ☐
40. District classes/ inservice ☐
41. School board presentations ☐
42. Community classes / service ☐
43. After-school classes / clubs ☐
44. Professional conferences ☐
45. TLP training sessions ☐
46. Technical support in building/district ☐
47. School/district technology committee ☐

48. Other_____

APPENDIX B
Technology Use Survey for Students

Technology Use Survey: Students
Teacher Leadership Project

Section 1: General and Demographic Information

1. Grade Level:
   ☐ 6-8 ☐ 9-12

2. Subject/class in which you use technology most often (other than a technology class):
   ☐ Language Arts ☐ Math ☐ Science ☐ Social Studies
   ☐ Fine Arts (Music, Drama) ☐ P.E. ☐ Foreign Language

3. Gender (Optional):
   ☐ Male ☐ Female

Section 2: Impact of Technology
Mark the response that most closely matches how you feel about using technology at school for learning.

	Strongly Agree	Agree	NA/Unsure	Agree	Strongly Disagree
	5	4	3	2	1
When I use computers and other technology...					
1. ...my schoolwork *looks* better.	5	4	3	2	1
2. ...I *learn* more.	5	4	3	2	1
3. ...I understand complicated ideas more clearly	5	4	3	2	1
4. ...school is more interesting.	5	4	3	2	1
5. ...I am more responsible for my own learning.	5	4	3	2	1
6. ...I am more motivated to do my work.	5	4	3	2	1
7. ...I get higher grades on my report card.	5	4	3	2	1
8. ...I work with other students more often.	5	4	3	2	1
9. ...I do work that is more meaningful.	5	4	3	2	1
10. ...I am a better problem-solver.	5	4	3	2	1
11. ...my work is more accurate.	5	4	3	2	1

Section 3: Your Technology Use at School
Mark the response that most closely matches your use of technology.

How often do you use computers for each of the following types of activities?

	Never	Hardly Ever	Sometimes	Very Often
	1	2	3	4
12. Practicing skills (math facts, etc)	1	2	3	4
13. Solving problems/analyzing data	1	2	3	4
14. Word processing	1	2	3	4
15. Creating graphs	1	2	3	4
16. Presentations and/or demonstrations	1	2	3	4
17. Research using the Internet/CD ROM	1	2	3	4
18. Communication using e-mail or the Internet	1	2	3	4
19. Drawing/artwork	1	2	3	4

20. Other _____

How much of a problem is each of the following issues in your classroom?

	Not a problem	Sometimes a problem	Often a problem
	1	2	3
21. We do not have enough computers	1	2	3
22. We do not have enough time to use the computers	1	2	3
23. We do not have enough room to easily use the computers	1	2	3
24. The computers often don't work	1	2	3
25. It is hard to connect to the Internet	1	2	3
26. I do not have enough skills to use the computers well	1	2	3

APPENDIX C
K-2 Interview and Observation Protocol

Teacher Leadership Project
K-2 Focus Study
Interview Protocol

Carol Stuen Brown, Ed.D.

Interview Questions

1. When utilizing technology, what are the most successful and productive activities for your students?

2. How much time do your students spend learning with technology?

3. How do you find a balance between technology and traditional activities?

4. Aside from learning about technology, how are your students better of because of being in a technology-rich classroom?

5. What are the biggest challenges to integrating technology?

6. What resources (hardware, software) are essential for integrating technology in a primary classroom?

7. What resources would be useful, but not absolutely essential?

K-2 Interview and Observation Protocol

Teacher Leadership Project
K-2 Focus Study
Observation Protocol

Carol Stuen Brown, Ed.D.

Technology Use Observations

1. Type/ # of Computers Used (Desk Top, Laptop, Notebook, Handheld)

2. Related Equipment Used (Cameras, Scanner, Projector, Probes, etc)

3. Room Set-Up

4. Software Used

5. Student to Computer Ratio (Individual Use, Group Use, # Students per group)

6. Type of Lesson (Research, Word Processing, Presentation)

7. Subject Area(s)

8. Keyboarding Skills

APPENDIX D
Year 3 and 4 Interview and Observation Protocol

Teacher Leadership Project
Year 3/4 Focus Study
Interview Protocol

Carol Stuen Brown, Ed.D.

Interview Questions

1. How have your efforts at integrating technology into the curriculum changed since you began your participation with the TLP? (Consider subject areas; amount of time the technology is used; useful applications and programs; skill level of students; class dynamics)

2. What are greatest benefits to having a technology-rich classroom, as envisioned and supported by the TLP? (For teachers? For students? For the school? For the community?)

3. What are the challenges and limitations to having a technology-rich classroom? (Consider student to computer ratio; classroom space and power supply; student management; available software; maintenance and tech support; standardized tests; state standards)

4. If you were to design a technology integration program such as the TLP, what would be the (5) most important elements to consider based on your experience?

5. Generally speaking, how will students be better off because of their participation in a TLP classroom?

6. Has your school changed because of your participation in TLP? How?

7. Has your community changed because of your participation in TLP? How?

8. Have you changed because of your participation in TLP? How? (Consider beliefs about teaching and learning; beliefs about the potential of technology)

9. What suggestions would you have for a teacher just starting their TLP training this summer?

Year 3 and 4 Interview and Observation Protocol

Teacher Leadership Project
Year 3/4 Focus Study
Observation Protocol

Carol Stuen Brown, Ed.D.

Technology Use Observations

1. Type/ # of Computers Used (Desk Top, Laptop, Notebook, Handheld)

2. Related Equipment Used (Cameras, Scanner, Projector, Probes, etc)

3. Room Set-Up

4. Software Used

5. Student to Computer Ratio (Individual Use, Group Use, # Students per group)

6. Type of Lesson (Research, Word Processing, Presentation)

7. Subject Area(s)

8. Keyboarding Skills

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